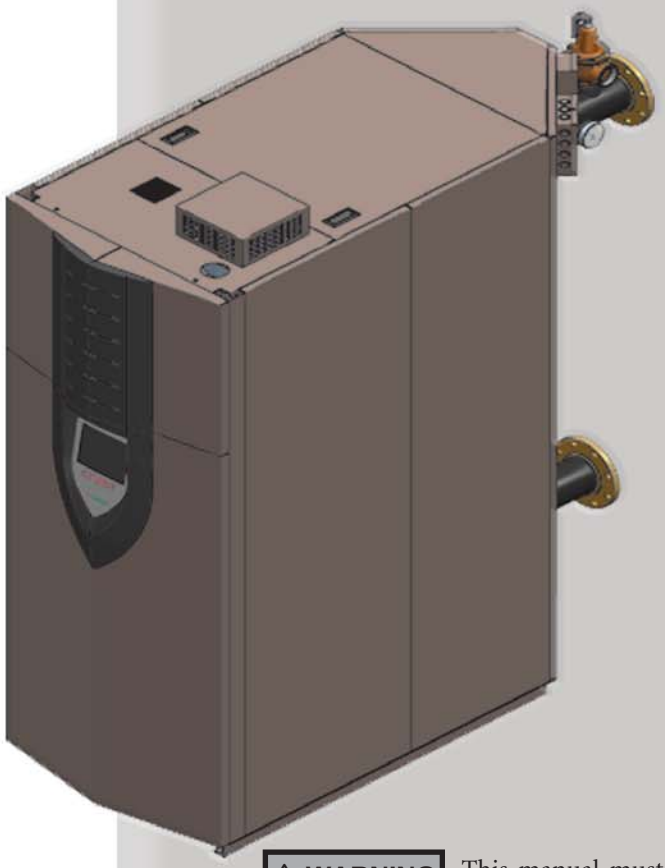
CREST®
CONDENSING BOILER

Installation & Operation Manual
Models: 1.5 - 2.0 - 2.5 - 3.0 - 3.5



DESIGN CERTIFIED®

CSA CERTIFIED®

⚠ WARNING This manual must only be used by a qualified heating installer / service technician. Read all instructions, including this manual and the Crest Service Manual, before installing. Perform steps in the order given. Failure to comply could result in severe personal injury, death, or substantial property damage.

Save this manual for future reference.

Lochinvar®
High Efficiency Water Heaters, Boilers and Pool Heaters

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Hazard definitions

The following defined terms are used throughout this manual to bring attention to the presence of hazards of various risk levels or to important information concerning the life of the product.

⚠ DANGER DANGER indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.

⚠ WARNING WARNING indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

⚠ CAUTION CAUTION indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.

CAUTION CAUTION used without the safety alert symbol indicates a potentially hazardous situation which, if not avoided, may result in property damage.

NOTICE NOTICE indicates special instructions on installation, operation, or maintenance that are important but not related to personal injury or property damage.

Please read before proceeding

⚠ WARNING

Installer – Read all instructions, including this manual and the Crest Service Manual, before installing. Perform steps in the order given.

User – This manual is for use only by a qualified heating installer/ service technician. Refer to the User's Information Manual for your reference.

Have this boiler serviced/inspected by a qualified service technician, at least annually.

Failure to comply with the above could result in severe personal injury, death or substantial property damage.

NOTICE

When calling or writing about the boiler – Please have the boiler model and serial number from the boiler rating plate.

Consider piping and installation when determining boiler location.

Any claims for damage or shortage in shipment must be filed immediately against the transportation company by the consignee.

Factory warranty (shipped with unit) does not apply to units improperly installed or improperly operated.

⚠ WARNING

Failure to adhere to the guidelines on this page can result in severe personal injury, death, or substantial property damage.

⚠ WARNING

If the information in this manual is not followed exactly, a fire or explosion may result causing property damage, personal injury or loss of life.

This appliance MUST NOT be installed in any location where gasoline or flammable vapors are likely to be present.

WHAT TO DO IF YOU SMELL GAS

- Do not try to light any appliance.
- Do not touch any electric switch; do not use any phone in your building.
- Immediately call your gas supplier from a near by phone. Follow the gas supplier's instructions.
- If you cannot reach your gas supplier, call the fire department.
- Installation and service must be performed by a qualified installer, service agency, or the gas supplier.

When servicing boiler –

- To avoid electric shock, disconnect electrical supply before performing maintenance.
- To avoid severe burns, allow boiler to cool before performing maintenance.

Boiler operation –

- Do not block flow of combustion or ventilation air to the boiler.
- Should overheating occur or gas supply fail to shut off, do not turn off or disconnect electrical supply to circulator. Instead, shut off the gas supply at a location external to the appliance.
- Do not use this boiler if any part has been under water. The possible damage to a flooded appliance can be extensive and present numerous safety hazards. Any appliance that has been under water must be replaced.

Boiler water –

- Thoroughly flush the system (without boiler connected) to remove sediment. The high-efficiency heat exchanger can be damaged by build-up or corrosion due to sediment.
- Do not use petroleum-based cleaning or sealing compounds in the boiler system. Gaskets and seals in the system may be damaged. This can result in substantial property damage.
- Do not use "homemade cures" or "boiler patent medicines". Serious damage to the boiler, personnel, and/or property may result.
- Continual fresh make-up water will reduce boiler life. Mineral buildup in the heat exchanger reduces heat transfer, overheats the stainless steel heat exchanger, and causes failure. Addition of oxygen carried in by makeup water can cause internal corrosion in system components. Leaks in boiler or piping must be repaired at once to prevent the need for makeup water.

Freeze protection fluids –

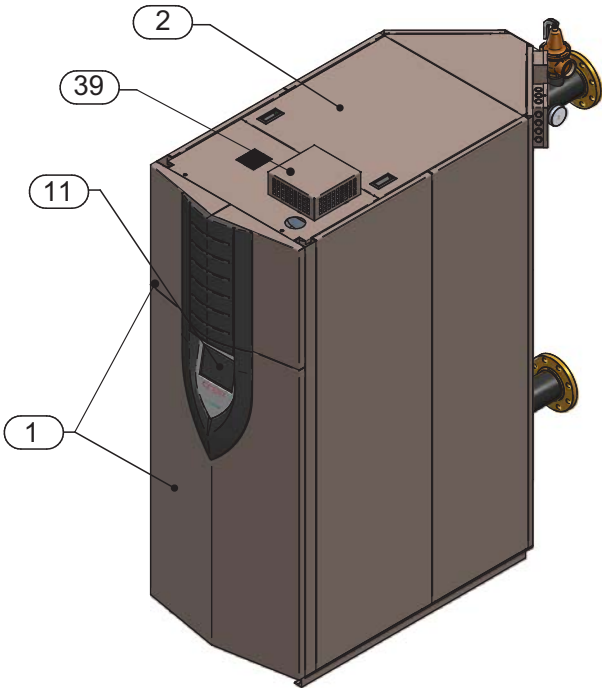
- NEVER use automotive antifreeze. Use only inhibited propylene glycol solutions, which are specifically formulated for hydronic systems. Ethylene glycol is toxic and can attack gaskets and seals used in hydronic systems.

The Crest - How it works...

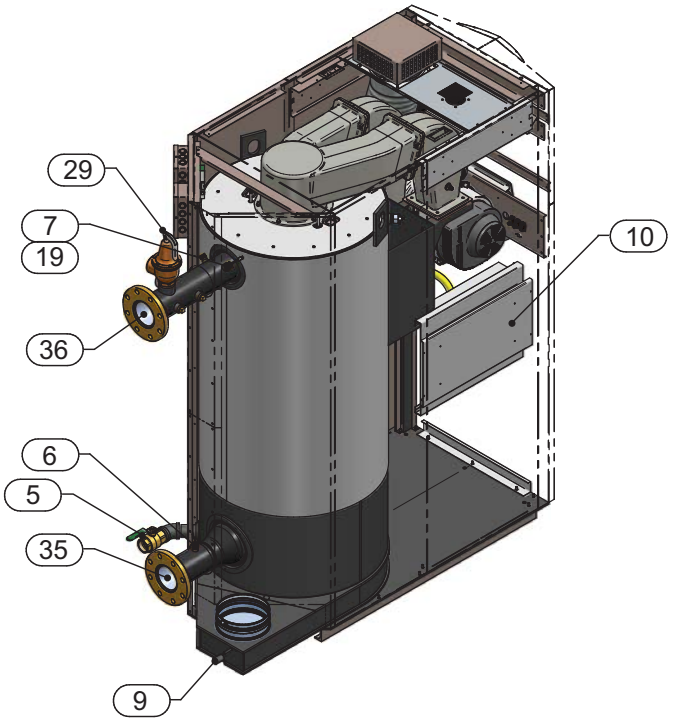
1. **Front access panels**
   Provides access to the controls compartment.
2. **Top access panel**
   Provides access to the burner compartment.
3. **Air pressure switch**
   The air pressure switch detects blocked flue/vent conditions.
4. **Blowers**
   The blowers pull in air and gas through the venturis (item 34). Air and gas mix inside the blowers and are pushed into the burner, where they burn inside the combustion chamber.
5. **Boiler drain connection**
   Location from which the heat exchanger can be drained.
6. **Boiler inlet temperature sensor**
   The boiler inlet temperature sensor monitors system return water temperature. If selected as the controlling sensor, the control module will adjust the boiler firing rate so the inlet temperature matches the set point.
7. **Boiler outlet temperature sensor**
   The boiler outlet temperature sensor monitors boiler outlet water temperature. If selected as the controlling sensor, the control module will adjust the boiler firing rate so the outlet temperature matches the set point.
8. **Burner (not shown)**
   Integral dual chamber design with a stress free metal fiber outer mesh and durable stainless steel structure. Provides two (2) independent firing rates up to 25:1 turndown.
9. **Condensate drain connection**
   The condensate drain connection provides a connection point to install a condensate drain line using flexible hose provided.
10. **Control module (on control panel assembly)**
    The control module responds to internal and external signals and controls the blowers, gas valves, and pump(s), depending on the application, to meet the heating demand.
11. **Electronic display**
    Digital controls with SMART TOUCH screen technology, full color display, and an 8" user interface screen.
12. **Flame inspection windows**
    Two large high temperature quartz observation windows provide views of each independent burner surface during firing.
13. **Dual flame sensors**
    The dual flame sensors are used by the control module to detect the presence of a burner flame at both independent burner surfaces.
14. **Flue temperature sensor**
    The flue sensor monitors flue gas temperature. The control module will modulate or shut the boiler down if the flue gas temperature gets too high.
15. **Gas connection pipe**
    The gas connection pipe is a threaded black iron pipe connection (see Gas Connections Section for specific model pipe size requirements). This pipe should be connected to the incoming gas supply to deliver gas to the boiler.
16. **Gas shutoff valve (inside unit)**
    The manual gas shutoff valve is used to isolate the boiler gas train from the gas supply.
17. **Gas valves**
    The gas valves sense the negative pressure created by the blowers, allowing gas to flow only if the gas valves are powered and combustion air is flowing.
18. **Blower proving switches**
    Prove adequate airflow during prepurge.
19. **High limit devices (primary and backup)**
    The high limit devices are used to monitor the outlet water temperature - if either device senses the water temperature exceeding the predetermined setting, the boiler will shut down.
20. **Ignition electrode**
    An electrical spark across the electrodes will ignite the first burner.
21. **Line voltage junction box**
    The line voltage junction box contains the connection points for the line voltage power to the boiler (and pumps if used).
22. **Line voltage wiring connections (knockouts)**
    Conduit connection points for the high voltage junction box.
23. **Low gas pressure switch**
    Monitors gas supply pressure to the boiler and shuts the boiler down in the event a low gas pressure condition occurs.
24. **High gas pressure switch (not shown)**
    Monitors gas supply pressure to the burner and shuts the boiler down in the event a high gas pressure condition occurs.
25. **Low voltage connection board(s)**
    Connection boards used to connect external low voltage devices.
26. **Low voltage wiring connections (knockouts)**
    Conduit connection points for the low voltage connection boards.
27. **Low water cutoff probe (LWCO)**
    Ensures adequate water is supplied to the boiler. In the event of inadequate water levels, the boiler will shut down.
28. **Power switch**
    The On/Off power switch provides the ability to turn line voltage power to the boiler on and off.
29. **Relief valve**
    The safety relief valve protects the heat exchanger from an over pressure condition. The boiler comes with a 50 PSI relief valve as standard equipment. Optional settings are available.
30. **Reset switch**
    Reset switch for the low water cutoff. Hold the switch for 10 seconds to reset.
31. **Test switch**
    The test switch permits manual triggering of the LWCO safety circuit to test the contacts and evaluate the integrity of the circuit. Hold the switch for 10 seconds to test.
32. **Firetube heat exchanger**
    High grade stainless steel WAVE™ firetube design that extracts heat from flue gases and transfers it directly into boiler water.
33. **Temperature and pressure gauge**
    Monitors the outlet temperature of the boiler as well as the system water pressure.
34. **Venturis**
    Separate venturis control air and gas flow into two (2) independent burner sections.
35. **Water inlet**
    A 4" ANSI flange connects the return water from the system to the heat exchanger.
36. **Water outlet**
    A 4" ANSI flange connects the hot water supply from the boiler to the system.
37. **Ignition transformer**
    The transformer provides voltage to the ignition electrode (item 20).
38. **Air arm temperature sensors (not shown)**
    Monitors fuel-air delivery temperature to the burner.
39. **Air inlet cover (shipped loose)**
    Used with room air for combustion and to prevent debris from entering the boiler.

The Crest - How it works... *(continued)*

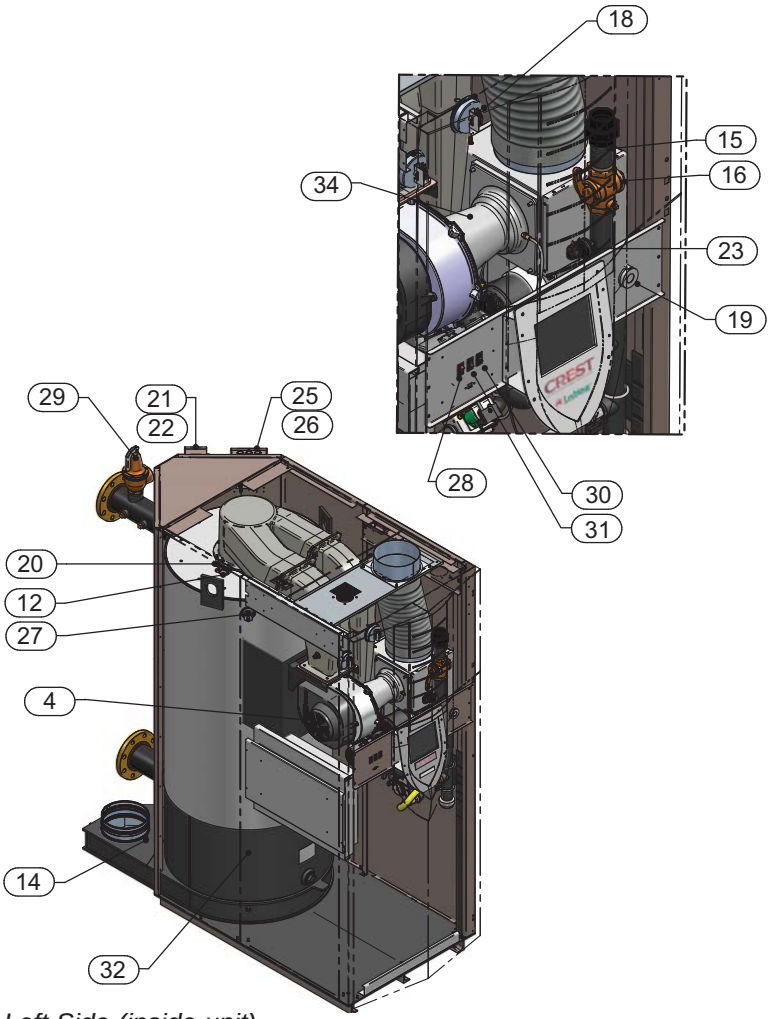
Models **1.5 - 2.0 - 2.5 - 3.0 - 3.5**



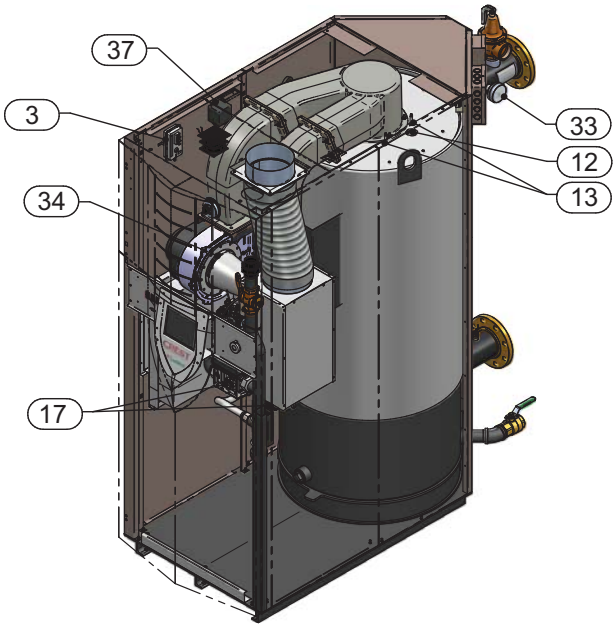
Front View



Rear View



Left Side (inside unit)



Right Side (inside unit)

Ratings

DOE

Crest I=B=R Rating					Other Specifications						
Model Number Note: Change "N" to "L" for L.P. gas models.	Input MBH (Note 4)		Gross Output MBH (Note 1)	Net I=B=R Ratings Water, MBH (Note 2)	Appliance Water Content Gallons	Pipe Size Outlet	Pipe Size Inlet	Gas Inlet Size	Air Size	Vent Size (Note 3)	Weight w/Water (lbs.)
	Min	Max									
FB(N,L)1500	60	1500	1380	1200	96	4"	4"	1 1/2"	7"	7"	2500
FB(N,L)2000	80	2000	1840	1600	132	4"	4"	1 1/2"	8"	8"	3055
FB(N,L)2500	125	2500	2300	2000	161	4"	4"	2"	8"	9"	3650
FB(N,L)3000	150	3000	2760	2400	181	4"	4"	2"	10"	10"	4125
FB(N,L)3500	200*	3500	3220	2800	215	4"	4"	2"	10"	10"	4750

*For LP models the minimum input is 420 MBH.

NOTICE Maximum allowed working pressure is located on the rating plate.

Notes:

1. The ratings are based on standard test procedures prescribed by the United States Department of Energy.
2. Net I=B=R ratings are based on net installed radiation of sufficient quantity for the requirements of the building and nothing need be added for normal piping and pickup. Ratings are based on a piping and pickup allowance of 1.15.
3. Crest boilers require special gas venting. Use only the vent materials and methods specified in the Crest Installation and Operation Manual.
4. Standard Crest boilers are equipped to operate from sea level to 4,500 feet **only** with no adjustments.
5. High altitude Crest boilers are equipped to operate from 3,000 to 12,000 feet. High altitude models are manufactured with different control parameters for high altitude operation, but the sequence of operation given in this manual remains the same as the standard boilers. A high altitude label (as shown in FIG A.) is also affixed to the unit.
6. The boiler will de-rate by 4% for each 1,000 feet above sea level up to 4,500 feet and 4.5% for each 1,000 feet above 4,500 feet.
7. Ratings have been confirmed by the Hydronics Institute, Section of AHRI.

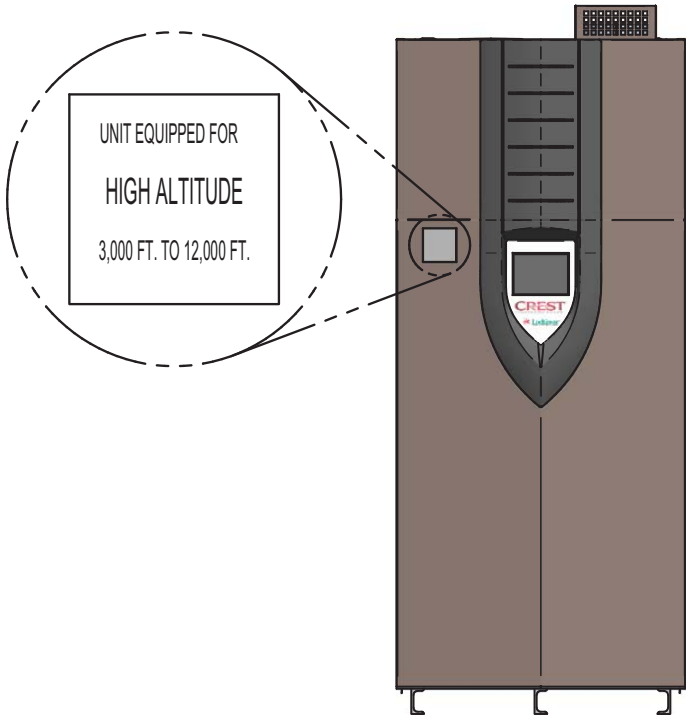


***Figure A** High Altitude Label Location*

1 Determine boiler location

Installation must comply with:

- Local, state, provincial, and national codes, laws, regulations, and ordinances.
- National Fuel Gas Code, NFPA 54 / ANSI Z223.1 – latest edition.
- Standard for Controls and Safety Devices for Automatically Fired Boilers, ANSI/ASME CSD-1 - latest edition, when required.
- National Electrical Code, NFPA 70 - latest edition.
- For Canada only: CSA B149.1 Installation Code, CSA C22.1 Canadian Electrical Code Part 1 and any local codes.

NOTICE The Crest gas manifold and controls met safe lighting and other performance criteria when the boiler underwent tests specified in ANSI Z21.13/CSA 4.9 – latest edition.

Before locating the boiler, check:

1. Check for nearby connection to:
   - System water piping
   - Venting connections
   - Gas supply piping
   - Electrical power
2. Locate the appliance so that if water connections should leak, water damage will not occur. When such locations cannot be avoided, it is recommended that a suitable drain pan, adequately drained, be installed under the appliance. The pan must not restrict combustion air flow. Under no circumstances is the manufacturer to be held responsible for water damage in connection with this appliance, or any of its components.
3. Check area around the boiler. Remove any combustible materials, gasoline and other flammable liquids.

⚠ WARNING Failure to keep boiler area clear and free of combustible materials, gasoline, and other flammable liquids and vapors can result in severe personal injury, death, or substantial property damage.

4. The Crest must be installed so that gas control system components are protected from dripping or spraying water or rain during operation or service.
5. If a new boiler will replace an existing boiler, check for and correct system problems, such as:
   - System leaks causing oxygen corrosion or heat exchanger cracks from hard water deposits.
   - Incorrectly-sized expansion tank.
   - Lack of freeze protection in boiler water causing system and boiler to freeze and leak.
6. The appliance must be installed on a level floor, both front to back and side to side, for proper condensate drainage.

⚠ WARNING This appliance is certified as an indoor appliance. Do not install the appliance outdoors or locate where the appliance will be exposed to freezing temperatures or to temperatures that exceed 100°F (37.8°C).

Do not install the appliance where the relative humidity may exceed 93%. Do not install the appliance where condensation may form on the inside or outside of the appliance, or where condensation may fall onto the appliance.

Failure to install the appliance indoors could result in severe personal injury, death, or substantial property damage.

⚠ WARNING This appliance requires a special venting system. Use only the vent materials specified in this manual. Failure to follow all instructions can result in flue gas spillage and carbon monoxide emissions, causing severe personal injury or death.

Provide clearances:

NOTICE If you do not provide the recommended service clearances shown, it may not be possible to service the boiler without removing it from the space.

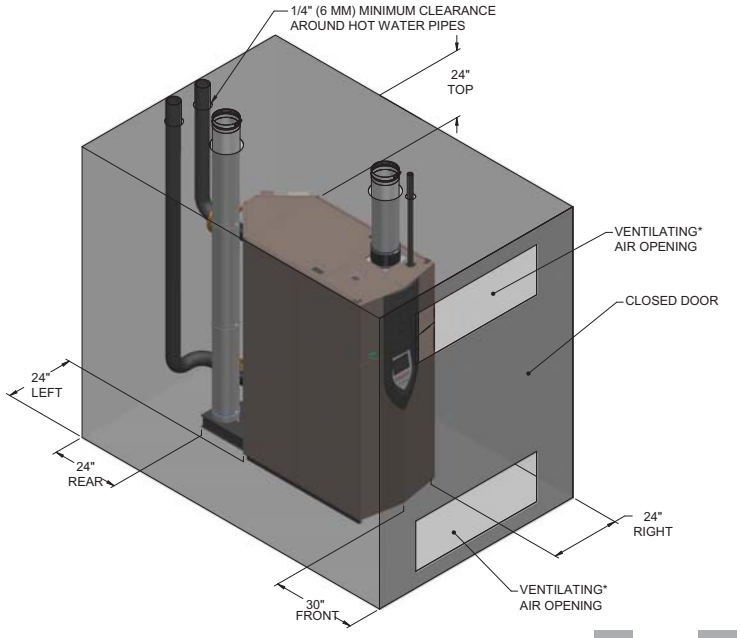
Clearances from combustible materials

- Hot water pipes..... 1/4"
- Sides..... 0"
- Rear..... 0"
- Front..... 0"
- Top ..... 0"
- Floor ..... Combustible
- Vent pipe - Follow special vent system manufacturer's instructions

Recommended clearances for service access

- Sides..... 24"
- Rear..... 24"
- Front..... 30"
- Top ..... 24"

Figure 1-1 *Recommended Service Clearances*



1 Determine boiler location

Provide air openings to room:

The Crest alone in boiler room

1. No air ventilation openings into the boiler room are needed when clearances around the Crest are at least equal to the SERVICE clearances shown in FIG. 1-1. For spaces that do NOT supply this clearance, provide two openings as shown in FIG. 1-1. Each opening must provide one square inch free area per 1,000 Btu/hr of boiler input.

2. Combustion air openings are required when using the Room Air Option on page 23 of this manual.

The Crest in same space with other gas or oil-fired appliances

1. Follow the National Fuel Gas Code (U.S.) or CSA B149.1 (Canada) to size/verify size of the combustion/ventilation air openings into the space.

⚠ WARNING The space must be provided with combustion/ventilation air openings correctly sized for all other appliances located in the same space as the Crest.

Failure to comply with the above warnings could result in severe personal injury, death, or substantial property damage.

2. Size openings only on the basis of the other appliances in the space. No additional air opening free area is needed for the Crest when it takes its combustion air from outside (direct vent installation).

Flooring and foundation

Flooring

The Crest is approved for installation on combustible flooring, but must never be installed on carpeting.

⚠ WARNING Do not install the boiler on carpeting even if foundation is used. Fire can result, causing severe personal injury, death, or substantial property damage.

If flooding is possible, elevate the boiler sufficiently to prevent water from reaching the boiler.

⚠ WARNING Assure that the floor and structure is sufficient to support the installed weight of the boiler, including the water content in the heat exchanger. If not, structural building failure will result, causing severe personal injury, death, or substantial property damage.

Vent and air piping

The Crest requires a special gas vent system, designed for pressurized venting.

The boiler is to be used for either direct vent installation or for installation using indoor combustion air. When room air is considered, see page 23 of this manual. Note prevention of combustion air contamination below when considering vent/air termination.

Vent and air must terminate near one another and may be vented vertically through the roof or out a side wall, unless otherwise specified. You may use any of the vent/air piping methods covered in this manual. Do not attempt to install the Crest using any other means.

Be sure to locate the boiler such that the vent and air piping can be routed through the building and properly terminated. The vent/air piping lengths, routing and termination method must all comply with the methods and limits given in this manual.

Prevent combustion air contamination

Install air inlet piping for the Crest as described in this manual. Do not terminate vent/air in locations that can allow contamination of combustion air. Refer to Table 1A, page 9 for products and areas which may cause contaminated combustion air.

⚠ WARNING Ensure that the combustion air will not contain any of the contaminants in Table 1A, page 9. Contaminated combustion air will damage the boiler, resulting in possible severe personal injury, death or substantial property damage. Do not pipe combustion air near a swimming pool, for example. Also, avoid areas subject to exhaust fumes from laundry facilities. These areas will always contain contaminants.

1 Determine boiler location *(continued)*

When using an existing vent system to install a new boiler:

⚠ WARNING Failure to follow all instructions can result in flue gas spillage and carbon monoxide emissions, causing severe personal injury or death.

Check the following venting components before installing:

- **Material** - For materials listed for use with this appliance, see Section 2 - General Venting, Table 2A. For stainless steel venting, an adapter of the same manufacturer (Table 2B) may be used at the flue collar connection.
- **Size** - To ensure proper pipe size is in place, see Table 2C. Check to see that this size is used throughout the vent system.
- **Manufacturer** - Only use the listed manufacturers and their type product listed in Table 2A for CAT IV positive pressure venting with flue producing condensate.
- **Supports** - Non-combustible supports must be in place allowing a minimum 1/4" rise per foot. The supports should adequately prevent sagging and vertical slippage, by distributing the vent system weight. For additional information, consult the vent manufacturer's instructions for installation.
- **Terminations** - Carefully review Sections 2 through 4 to ensure requirements for the location of the vent and air terminations are met and orientation of these fit the appropriate image from the Sidewall or Vertical options listed in the General Venting Section.
- **Seal** - With prior requirements met, the system should be tested to the procedure listed in parts (c) through (f) of the Removal of an Existing Boiler Section on page 10.

With stainless steel vent, seal and connect all pipe and components as specified by the vent manufacturer used.

⚠ WARNING If any of these conditions are not met, the existing system must be updated or replaced for that concern. Failure to follow all instructions can result in flue gas spillage and carbon monoxide emissions, causing severe personal injury or death.

***Table 1A** Corrosive Contaminants and Sources*

Products to avoid:
Spray cans containing chloro/fluorocarbons
Permanent wave solutions
Chlorinated waxes/cleaners
Chlorine-based swimming pool chemicals
Calcium chloride used for thawing
Sodium chloride used for water softening
Refrigerant leaks
Paint or varnish removers
Hydrochloric acid/muriatic acid
Cements and glues
Antistatic fabric softeners used in clothes dryers
Chlorine-type bleaches, detergents, and cleaning solvents found in household laundry rooms
Adhesives used to fasten building products and other similar products
Areas likely to have contaminants
Dry cleaning/laundry areas and establishments
Swimming pools
Metal fabrication plants
Beauty shops
Refrigeration repair shops
Photo processing plants
Auto body shops
Plastic manufacturing plants
Furniture refinishing areas and establishments
New building construction
Remodeling areas
Garages with workshops

1 Determine boiler location

When removing a boiler from existing common vent system:

⚠ DANGER Do not install the Crest into a common vent with any other appliance except as noted in Section 2 on page 18. This will cause flue gas spillage or appliance malfunction, resulting in possible severe personal injury, death, or substantial property damage.

⚠ WARNING Failure to follow all instructions can result in flue gas spillage and carbon monoxide emissions, causing severe personal injury or death.

At the time of removal of an existing boiler, the following steps shall be followed with each appliance remaining connected to the common venting system placed in operation, while the other appliances remaining connected to the common venting system are not in operation.

a. Seal any unused openings in the common venting system.

b. Visually inspect the venting system for proper size and horizontal pitch and determine there is no blockage or restriction, leakage, corrosion, or other deficiencies, which could cause an unsafe condition.

c. Test vent system – Insofar as is practical, close all building doors and windows and all doors between the space in which the appliances remaining connected to the common venting system are located and other spaces of the building. Turn on clothes dryers and any appliance not connected to the common venting system. Turn on any exhaust fans, such as range hoods and bathroom exhausts, so they will operate at maximum speed. Do not operate a summer exhaust fan. Close fireplace dampers.

d. Place in operation the appliance being inspected. Follow the lighting instructions. Adjust thermostat so appliance will operate continuously.

e. Test for spillage at the draft hood relief opening after 5 minutes of main burner operation. Use the flame of a match or candle, or smoke from a cigarette, cigar, or pipe.

f. After it has been determined that each appliance remaining connected to the common venting system properly vents when tested as outlined herein, return doors, windows, exhaust fans, fireplace dampers, and any other gas-burning appliance to their previous conditions of use.

g. Any improper operation of the common venting system should be corrected so the installation conforms with the National Fuel Gas Code, ANSI Z223.1/NFPA 54 and/or CAN/CSA B149.1, Natural Gas and Propane Installation Code. When resizing any portion of the common venting system, the common venting system should be resized to approach the minimum size as determined using the appropriate tables in Part 11 of the National Fuel Gas Code, ANSI Z223.1/NFPA 54 and/or CAN/CSA B149.1, Natural Gas and Propane Installation Code.

1 Determine boiler location *(continued)*

Remove boiler from wood pallet

1. After removing the outer shipping crate and plastic from the boiler, remove the parts package (packaged parts inside the controls compartment of the boiler inside the lower front access panel).

2. To remove the boiler from the pallet:

a. Remove the three (3) shipping bolts located inside the controls compartment securing the boiler to the front of the pallet (see FIG. 1-2).

b. Remove the three (3) shipping bolts that fasten the tie-down brackets securing the legs to the rear of the pallet (FIG. 1-2).

c. The boiler can now be removed from the pallet using a lift truck lifting from the front or rear of the boiler. If lifting from the front, the lift truck forks must extend at least half way under the boiler heat exchanger to assure proper lifting technique with no damage to the boiler.

⚠ WARNING Failure to assure the truck forks are long enough to extend at least halfway under the boiler heat exchanger will result in the boiler tipping off the lift truck, and potentially falling. This will result in severe personal injury, death, or substantial property damage.

d. If lifting by crane is desired, remove the top access panels to gain access to the lifting lugs located on the boiler (see FIG. 1-3). It is also recommended that the upper and lower front panels along with both front side panels be removed (no tools required).

NOTICE Do not drop the boiler or bump the jacket on the floor or pallet. Damage to the boiler can result.

Figure 1-2 *Boiler Mounted on Shipping Pallet*

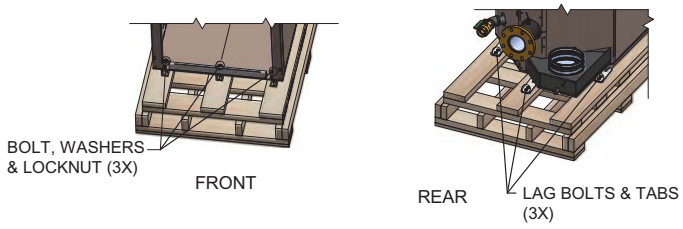
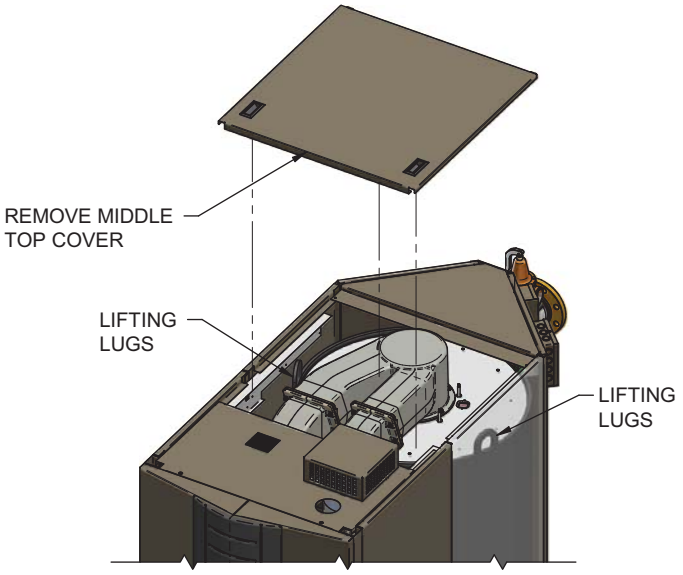


Figure 1-3 *Boiler Removed from Shipping Pallet*



Maintain minimum specified clearances for adequate operation. All installations must allow sufficient space for servicing the vent connections, water pipe connections, piping and other auxiliary equipment, as well as the appliance. The clearance labels on each appliance note the same service and combustible clearance requirements as shown in this manual.

Multiple boilers may be installed side by side with no clearance between adjacent boilers because this boiler is approved for zero clearance from combustible surfaces; however, service access will be limited from the sides.

Consult the *Venting* section of this manual for specific installation instructions for the appropriate type of venting system that you will be using.

1 Determine boiler location

Combustion and ventilation air requirements for appliances drawing air from the equipment room

Provisions for combustion and ventilation air must be in accordance with Air for Combustion and Ventilation, of the latest edition of the National Fuel Gas Code, NFPA 54 / ANSI Z223.1, in Canada, the latest edition of CGA Standard B149 Installation Code for Gas Burning Appliances and Equipment, or applicable provisions of the local building codes.

The equipment room MUST be provided with properly sized openings and/or be of sufficient volume to assure adequate combustion air and proper ventilation for all gas fired appliances in the equipment room to assure adequate combustion air and proper ventilation.

The requirements shown are for the **appliance only**; additional gas fired appliances in the equipment room will require an increase in the net free area and/or volume to supply adequate combustion air for all appliances.

No combustion air openings are needed when the appliance is installed in a space with a volume **NO LESS** than 50 cubic feet per 1,000 Btu/hr of all installed gas fired appliances and the building **MUST NOT be of "Tight Construction"**[3].

A combination of indoor and outdoor combustion air may be utilized by applying a ratio of available volume to required volume times the required outdoor air opening(s) size(s). This must be done in accordance with the National Fuel Gas Code, NFPA 54 / ANSI Z223.1.

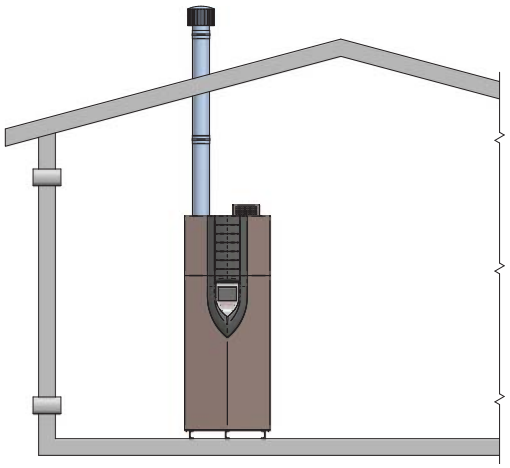


***Figure 1-4**_Combustion Air Direct from Outside*

1. If air is taken directly from outside the building with no duct, provide two permanent openings to the equipment room each with a net free area of one square inch per 4000 Btu/hr input (5.5 cm^2 per kW) (see FIG. 1-4).

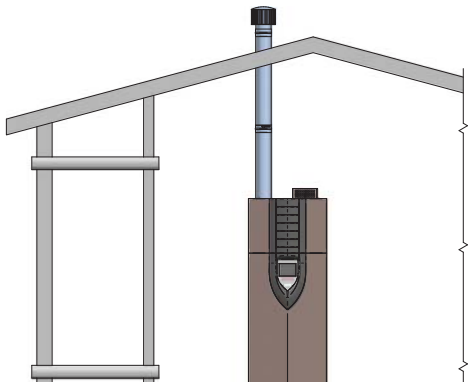


***Figure 1-5**_Combustion Air Through Ducts*

2. If combustion and ventilation air is taken from the outdoors using a duct to deliver the air to the equipment room, each of the two openings should be sized based on a minimum free area of one square inch per 2000 Btu/hr (11 cm^2 per kW) of input (see FIG. 1-5).

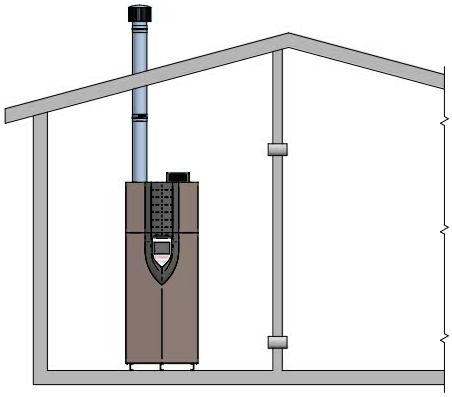


***Figure 1-6**_Combustion Air from Interior Space*

3. If air is taken from another interior space combined with the equipment room:

(a) Two spaces on same story: Each of the two openings specified above should have a net free area of one square inch for each 1000 Btu/hr (22 cm^2 per kW) of input, but not less than 100 square inches (645 cm^2) (see FIG. 1-6).

(b) Two spaces on different stories: One or more openings should have a net free area of two square inches per 1000 Btu/hr (44 cm^2 per kW).

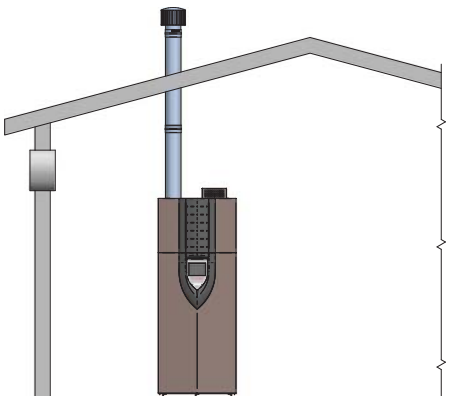


***Figure 1-7**_Combustion Air from Outside - Single Opening*

1 Determine boiler location *(continued)*

4. If a single combustion air opening is provided to bring combustion air in directly from the outdoors, the opening must be sized based on a minimum free area of one square inch per 3000 Btu/hr (7 cm^2 per kW). This opening must be located within 12" (30 cm) of the top of the enclosure (see FIG. 1-7).

Combustion air requirements are based on the latest edition of the National Fuel Gas Code, NFPA 54 / ANSI Z223.1; in Canada refer to the latest edition of CGA Standard CAN/CSA B149.1. Check all local code requirements for combustion air.

All dimensions based on net free area in square inches. Metal louvers or screens reduce the free area of a combustion air opening a minimum of approximately 25%. Check with louver manufacturers for exact net free area of louvers.

Where two openings are provided, one must be within 12" (30 cm) of the ceiling and one must be within 12" (30 cm) of the floor of the equipment room. Each opening must have a net free area as specified in Table 1B. Single openings shall commence within 12" (30 cm) of the ceiling. The minimum dimension of air openings shall not be less than 3" (80 mm).

⚠ CAUTION Under no circumstances should the equipment room ever be under negative pressure. Particular care should be taken where exhaust fans, attic fans, clothes dryers, compressors, air handling units, etc., may take away air from the unit.

The combustion air supply must be completely free of any flammable vapors that may ignite or chemical fumes which may be corrosive to the appliance. Common corrosive chemical fumes which must be avoided are fluorocarbons and other halogenated compounds, most commonly present as refrigerants or solvents, such as Freon, trichlorethylene, perchlorethylene, chlorine, etc. These chemicals, when burned, form acids which quickly attack the stainless steel heat exchanger, headers, flue collectors, and the vent system.

The result is improper combustion and a non-warrantable, premature appliance failure.

EXHAUST FANS: Any fan or equipment which exhausts air from the equipment room may deplete the combustion air supply and/or cause a downdraft in the venting system. Spillage of flue products from the venting system into an occupied living space can cause a very hazardous condition that must be corrected immediately.

TABLE - 1B
MINIMUM RECOMMENDED COMBUSTION AIR SUPPLY TO EQUIPMENT ROOM

Model Number	FIG. 1-4		FIG. 1-5		FIG. 1-6			FIG. 1-7
	*Outside Air from 2 Openings Directly from Outdoors[1]		*Outside Air from 2 Ducts Delivered from Outdoors[1]		Inside Air from 2 Ducts Delivered from Interior Space[2]			*Outside Air from 1 Opening Directly from Outdoors, in^2 (cm^2)[1]
					Same Story		Different Stories	
	Top Opening, in^2 (cm^2)	Bottom Opening, in^2 (cm^2)	Top Opening, in^2 (cm^2)	Bottom Opening, in^2 (cm^2)	Top Opening, in^2 (cm^2)	Bottom Opening, in^2 (cm^2)	Total Opening, in^2 (cm^2)	
FB 1500	375 (2420)	375 (2420)	750 (4839)	750 (4839)	1500 (9678)	1500 (9678)	3000 (19355)	500 (3226)
FB 2000	500 (3226)	500 (3226)	1000 (6452)	1000 (6452)	2000 (12904)	2000 (12904)	4000 (25807)	667 (4304)
FB 2500	625 (4033)	625 (4033)	1250 (8065)	1250 (8065)	2500 (16129)	2500 (16129)	5000 (32258)	833 (5381)
FB 3000	750 (4839)	750 (4839)	1500 (9678)	1500 (9678)	3000 (19355)	3000 (19355)	6000 (38710)	1000 (6452)
FB 3500	875 (5646)	875 (5646)	1750 (11291)	1750 (11291)	3500 (22581)	3500 (22581)	7000 (45162)	1167 (7530)

The above requirements are for the **appliance only**; additional gas fired appliances in the equipment room will require an increase in the net free area and/or volume to supply adequate combustion air for all appliances.

No combustion air openings are needed when the appliance is installed in a space with a volume NO LESS than 50 cubic feet per 1,000 Btu/hr of all installed gas fired appliances. **Buildings MUST NOT be of *"Tight Construction"[3].**

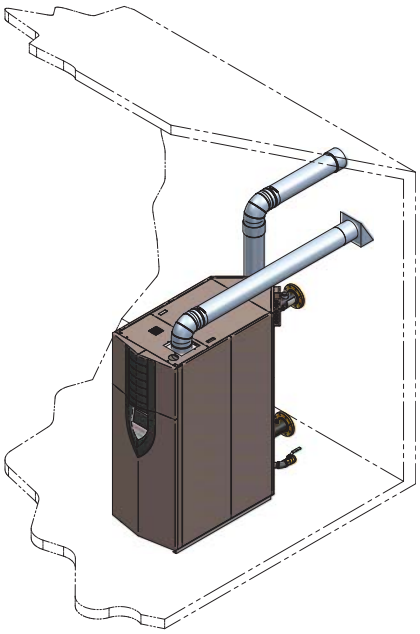
[1]Outside air openings shall directly communicate with the outdoors.

[2]Combined interior space must be 50 cubic feet per 1,000 Btu/hr input. **Buildings MUST NOT be of *"Tight Construction".**

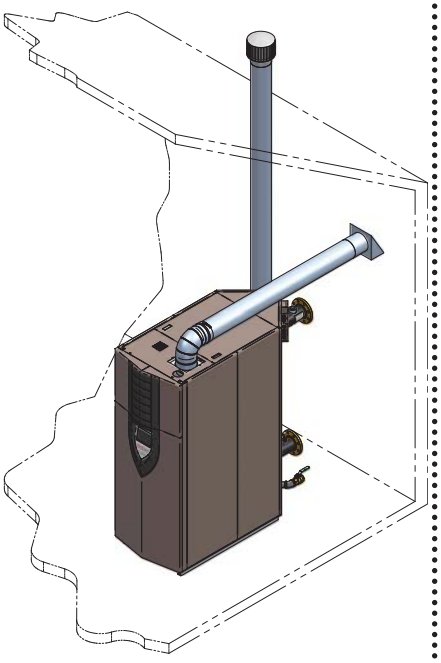
[3]**"Tight Construction"** is defined as a building with less than 0.40 ACH (air changes per hour). For buildings of **"Tight Construction"**, provide air openings into the building from outside.

2 General venting

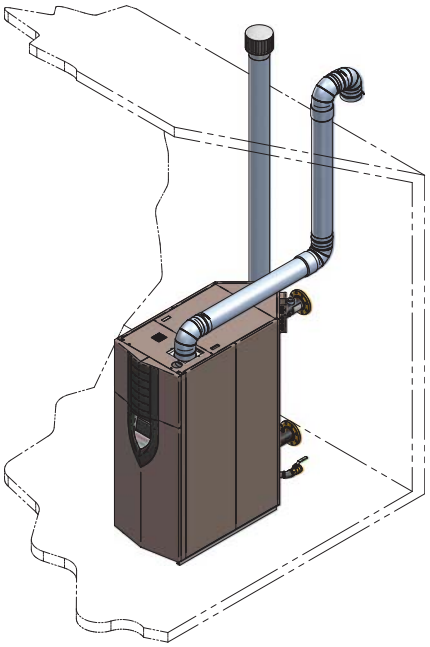
Direct venting



Sidewall

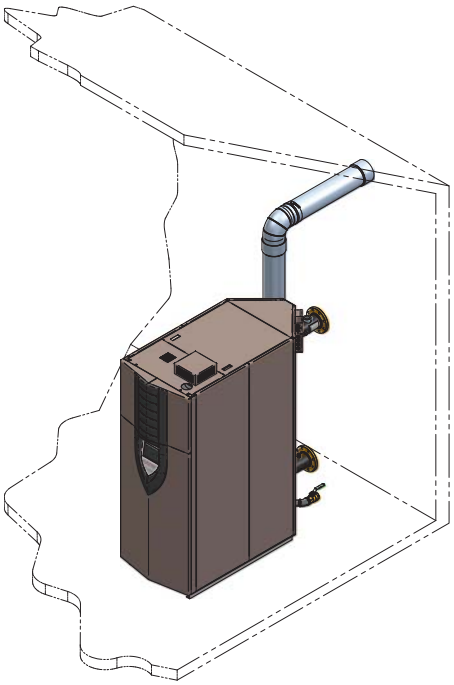


Vertical Vent, Sidewall Air

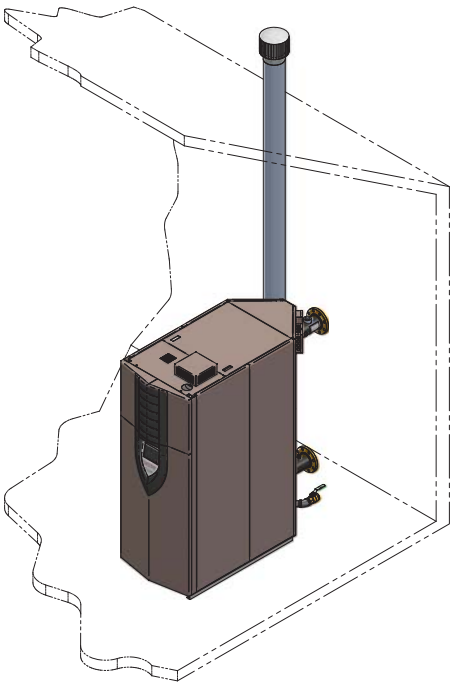


Vertical

Optional room air



Sidewall



Vertical

2 General venting *(continued)*

Install vent and combustion air piping

⚠ DANGER

The Crest must be vented and supplied with combustion and ventilation air as described in this section. Ensure the vent and air piping and the combustion air supply comply with these instructions regarding vent system, air system, and combustion air quality. See also Section 1 of this manual.

Inspect finished vent and air piping thoroughly to ensure all are airtight and comply with the instructions provided and with all requirements of applicable codes.

Failure to provide a properly installed vent and air system will cause severe personal injury or death.

Air inlet pipe materials:

The air inlet pipe(s) must be sealed. Choose acceptable combustion air inlet pipe materials from the following list:

ABS, PVC, or CPVC
Dryer Vent or Sealed Flexible Duct (not recommended for rooftop air inlet)
Galvanized steel vent pipe with joints and seams sealed as specified in this section.
Type "B" double-wall vent with joints and seams sealed as specified in this section.
AL29-4C, stainless steel material to be sealed to specification of its manufacturer.

*Plastic pipe may require an adapter (not provided) to transition between the air inlet connection on the appliance and the plastic air inlet pipe.

⚠ WARNING

Using vent or air intake materials other than those specified, failure to properly seal all seams and joints or failure to follow vent pipe manufacturer's instructions can result in personal injury, death or property damage. Mixing of venting materials will void the warranty and certification of the appliance.

NOTICE

The use of double-wall vent or insulated material for the combustion air inlet pipe is recommended in cold climates to prevent the condensation of airborne moisture in the incoming combustion air.

Sealing of Type "B" double-wall vent material or galvanized vent pipe material used for air inlet piping on a sidewall or vertical rooftop Combustion Air Supply System:

a. Seal all joints and seams of the air inlet pipe using either Aluminum Foil Duct Tape meeting UL Standard 723 or 181A-P or a high quality UL Listed silicone sealant such as those manufactured by Dow Corning or General Electric.

b. Do not install seams of vent pipe on the bottom of horizontal runs.

c. Secure all joints with a minimum of three sheet metal screws or pop rivets. Apply Aluminum Foil Duct Tape or silicone sealant to all screws or rivets installed in the vent pipe.

d. Ensure that the air inlet pipes are properly supported.

The PVC, CPVC, or ABS air inlet pipe should be cleaned and sealed with the pipe manufacturer's recommended solvents and standard commercial pipe cement for the material used. The ABS, PVC, CPVC, Dryer Vent or Flex Duct air inlet pipe should use a silicone sealant to ensure a proper seal at the appliance connection and the air inlet cap connection. Dryer vent or flex duct should use a screw type clamp to seal the vent to the appliance air inlet and the air inlet cap. Proper sealing of the air inlet pipe ensures that combustion air will be free of contaminants and supplied in proper volume.

2 General venting

When a sidewall or vertical rooftop combustion air supply system is disconnected for any reason, the air inlet pipe must be resealed to ensure that combustion air will be free of contaminants and supplied in proper volume.

⚠ DANGER Failure to properly seal all joints and seams as required in the air inlet piping may result in flue gas recirculation, spillage of flue products and carbon monoxide emissions causing severe personal injury or death.

Vent and air piping

This product has been approved for use with stainless steel vent systems.

⚠ WARNING Use only the materials, vent systems, and terminations listed in Table 2A. DO NOT mix vent systems of different types or manufacturers, unless listed in this manual. Failure to comply could result in severe personal injury, death, or substantial property damage.

NOTICE Installations must comply with applicable national, state, and local codes. Stainless steel vent systems must be listed as a UL-1738 approved system for the United States and a ULC-S636 approved system for Canada.

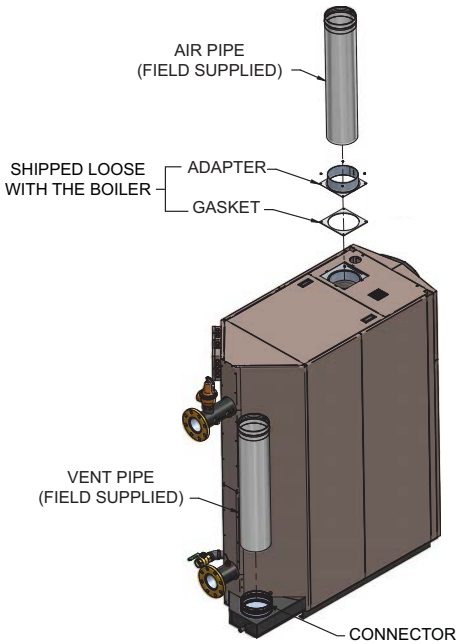
NOTICE Installation of a stainless steel vent system should adhere to the stainless steel vent manufacturer's installation instructions supplied with the vent system.

NOTICE The Crest is supplied with an integral FasNSeal vent connector (FIG. 2-1). The installer must use a specific vent starter adapter supplied by the vent manufacturer to adapt to different vent systems.

Air intake/vent connections

1. **Combustion Air Intake Connector** (FIG. 2-1) - Used to provide combustion air directly to the unit from outdoors. A fitting is provided with the unit for final connection. Combustion air piping must be supported per guidelines listed in the National Mechanical Code, Section 305, Table 305.4 or as local codes dictate.
2. **Vent Connector** (FIG. 2-1) - Used to provide a passageway for conveying combustion gases to the outside. A transition fitting is provided on the unit for final connection. Vent piping must be supported per the National Building Code, Section 305, Table 305.4 or as local codes dictate.

Figure 2-1 *Combustion Air Adapter*



The Crest uses model specific combustion air intake and vent piping sizes as detailed in Tables 2B and 2C on page 17.

NOTICE Increasing or decreasing combustion air or vent piping to sizes not specified in this manual is not authorized.

Table 2A *Approved Stainless Steel Vent Manufacturers*

Approved Stainless Steel Vent Manufacturers	
Make	**Model**
ProTech Systems (Simpson Dura-Vent Co.)	FasNSeal Vent
Z-Flex (Nova Flex Group)	Z-Vent
Heat Fab (Selkirk Corporation)	Saf-T Vent
Metal Fab	Corr/Guard
Securities Chimneys International	Secure Seal SS
Schebler Chimney Systems	eVent

2 General venting *(continued)*

Table 2B *Direct Vent Minimum / Maximum Allowable Air / Vent Lengths*

Model	AIR INLET			VENT			Input De-Rate per 25 feet of Vent
	Air Intake Diameter	Air Intake Min. Length	Air Intake Max. Length	Vent Diameter	Vent Min. Length	Vent Max. Length	
FB 1500	7"	12'	100'	7"	12'	100'	2%
FB 2000	8"	12'	100'	8"	12'	100'	2%
FB 2500	8"	12'	100'	9"	12'	100'	2%
FB 3000	10"	12'	100'	10"	12'	100'	2%
FB 3500	10"	12'	100'	10"	12'	100'	2%

Table 2C *Room Air Minimum / Maximum Allowable Air / Vent Lengths*

Model	Vent Diameter	Vent Min. Length	Vent Max. Length	Input De-Rate per 25 feet of Vent
FB 1500	7"	12'	100'	1%
FB 2000	8"	12'	100'	1%
FB 2500	9"	12'	100'	1%
FB 3000	10"	12'	100'	1%
FB 3500	10"	12'	100'	1%

When determining equivalent combustion air and vent length, add 5 feet (1.5m) for each 90° elbow and 3 feet (.9 m) for each 45° elbow.

EXAMPLE: 20 feet (6 m) of pipe + (4) 90° elbows + (3) 45° elbows = 49 equivalent feet (15 m) of piping.

Removing from existing vent

Follow the instructions in Section 1, page 10 of this manual when removing a boiler from an existing vent system.

Vent and air piping

Vent and air system:

NOTICE Installation must comply with local requirements and with the National Fuel Gas Code, NFPA 54 / ANSI Z223.1 for U.S. installations or CSA B149.1 for Canadian installations.

You must also install air piping from outside to the boiler air intake adapter. The resultant installation is direct vent (sealed combustion).

You may use any of the vent/air piping methods covered in this manual. Do not attempt to install the Crest using any other means.

⚠ WARNING DO NOT mix components from different systems. The vent system could fail, causing leakage of flue products into the living space. Use only approved stainless steel pipe and fittings.

Vent, air piping and termination:

The Crest vent and air piping can be installed through the roof or through a sidewall. Follow the procedures in this manual for the method chosen. Refer to the information in this manual to determine acceptable vent and air piping length.

Air contamination

Pool and laundry products and common household and hobby products often contain fluorine or chlorine compounds. When these chemicals pass through the boiler, they can form strong acids. The acid can eat through the boiler wall, causing serious damage and presenting a possible threat of flue gas spillage or boiler water leakage into the building.

Please read the information given in Table 1A, page 9, listing contaminants and areas likely to contain them. If contaminating chemicals will be present near the location of the boiler combustion air inlet, have your installer pipe the boiler combustion air and vent to another location, per this manual.

⚠ WARNING If the boiler combustion air inlet is located in a laundry room or pool facility, for example, these areas will always contain hazardous contaminants.

⚠ WARNING To prevent the potential of severe personal injury or death, check for areas and products listed in Table 1A, page 9 before installing the boiler or air inlet piping.

If contaminants are found, you MUST:

- Remove products permanently.

—OR—

- Relocate air inlet and vent terminations to other areas.

2 General venting

Common venting

Crest boilers may be common vented; however, the following criteria MUST BE followed:

1. Only Crest boilers may be connected to the common vent. DO NOT mix other manufacturer's appliances or other Lochinvar models.

2. Crest boilers connected to the common vent must all be of the same size.

3. Each Crest boiler must have a Lochinvar supplied flue damper installed (see Table 2D).

4. Only vertical venting may be used when common venting Crest boilers. Sidewall venting is not allowed.

5. Crest boilers in a common vent must be connected and controlled with the integral Crest SMART TOUCH Cascade.
   a. The Leader may be controlled through the Crest SMART TOUCH control through BMS (external 0 - 10V signal), ModBus or its own internally calculated set point.
   b. The Cascade (Members) must be controlled by the Crest Leader boiler using the efficiency optimized Cascade.

For approved common vent sizing, contact the factory.

⚠ WARNING When Crest boilers are common vented, the criteria above MUST BE followed. Failure to follow all these requirements will result in severe personal injury, death, or substantial property damage.

***Table 2D** Flue Damper Kits*

Flue Damper Kits		
Model	**Damper Size**	**Kit Number**
FB1500	7"	DRH30000
FB2000	8"	DRH30001
FB2500	9"	DRH30002
FB3000	10"	DRH30003
FB3500	10"	DRH30003

3 Vertical direct venting

Vent/air termination – vertical

⚠ WARNING Follow instructions below when determining vent location to avoid possibility of severe personal injury, death or substantial property damage.

⚠ WARNING Do not connect any other appliance to the vent pipe or multiple boilers to a common vent pipe except as noted in Section 2 on page 18. Failure to comply could result in severe personal injury, death, or substantial property damage.

NOTICE Installation must comply with local requirements and with the National Fuel Gas Code, NFPA 54 / ANSI Z223.1 - latest edition for U.S. installations or CSA B149.1 Installation Code for Canadian installations.

Determine location

Locate the vent/air terminations using the following guidelines:

1. The total length of piping for vent or air must not exceed the limits given in the General Venting Section on page 17 of this manual.
2. The vent must terminate at least 3 feet above the highest place in which the vent penetrates the roof and at least 2 feet above any part of a building within 10 horizontal feet.
3. The air piping must terminate in a down-turned 180° return pipe no further than 2 feet (.6 m) from the center of the vent pipe. This placement avoids recirculation of flue products into the combustion air stream.
4. The vent piping must terminate in an up-turned coupling as shown in FIG. 3-1. The top of the coupling or the rain cap must be at least 36" (914 mm) above the air intake. The air inlet pipe and vent pipe can be located in any desired position on the roof, but must always be no further than 2 feet (.6 m) apart and with the vent termination at least 36" (914 mm) above the air intake.

⚠ WARNING Rooftop vent and air inlet terminations must terminate in the same pressure zone, unless vertical vent sidewall air is set up as shown in the General Venting - Vertical Vent, Sidewall Air Section.

Figure 3-1 *Vertical Termination of Air and Vent*

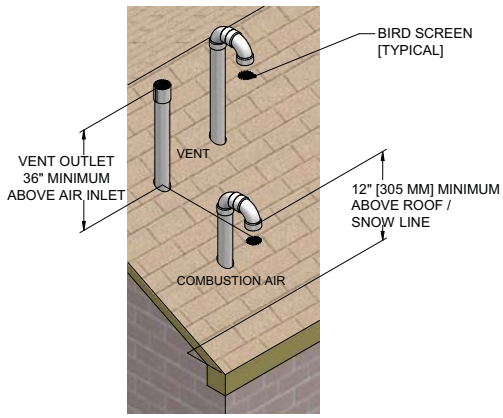
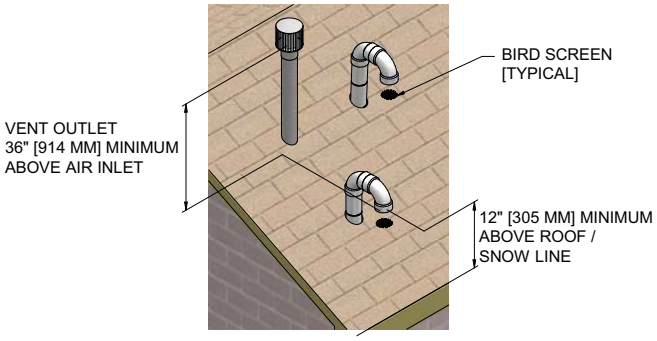


Figure 3-2 *Vertical Termination of Air and Vent w/Rain Cap*



5. Locate terminations so they are not likely to be damaged by foreign objects, such as stones or balls, or subject to buildup of leaves or sediment.

Prepare roof penetrations

1. Air pipe penetration:
   a. Cut a hole for the air pipe. Size the air pipe hole as close as desired to the air pipe outside diameter.
2. Vent pipe penetration:
   a. Cut a hole for the vent pipe. For either combustible or noncombustible construction, size the vent pipe hole per the vent manufacturer's instructions.
   b. Insert a galvanized metal thimble in the vent pipe hole (when required by local codes).
3. Space the air and vent holes to provide the minimum spacing shown in FIG. 3-1.
4. Follow all local codes for isolation of vent pipe when passing through floors, ceilings, and roofs.
5. Provide flashing and sealing boots sized for the vent pipe and air pipe.

Termination and fittings

1. Prepare the vent termination coupling and the air termination elbow (FIG. 3-1) by inserting bird screens. Bird screens should be obtained locally.
2. The air piping must terminate in a down-turned 180° return bend as shown in FIG. 3-1. Locate the air inlet pipe no further than 2 feet (.6 m) from the center of the vent pipe. This placement avoids recirculation of flue products into the combustion air stream.

3 Vertical direct venting

3. The vent piping must terminate in an up-turned coupling as shown in FIG. 3-1. The top of the coupling or the rain cap must be at least 36" (914 mm) above the air intake. The air inlet pipe and vent pipe can be located in any desired position on the roof, but must always be no further than 2 feet (.6 m) apart and with the vent termination at least 36" (914 mm) above the air intake.
4. Maintain the required dimensions of the finished termination piping as shown in FIG. 3-1.
5. Do not extend exposed vent pipe outside of building more than shown in this document. Condensate could freeze and block vent pipe.

Multiple vent/air terminations

1. When terminating multiple Crest boilers, terminate each vent/air connection as described in this manual (FIG. 3-3).

⚠ WARNING Terminate all vent pipes at the same height and all air pipes at the same height to avoid recirculation of flue products and the possibility of severe personal injury, death, or substantial property damage.

2. Place roof penetrations to obtain minimum clearance of 12 inches (305 mm) between edge of air intake elbow and adjacent vent pipe of another boiler for U.S. installations (see FIG. 3-3). For Canadian installations, provide clearances required by CSA B149.1 Installation Code.
3. The air inlet of a Crest boiler is part of a direct vent connection. It is not classified as a forced air intake with regard to spacing from adjacent boiler vents.

Figure 3-3 *Vertical Terminations with Multiple Boilers*

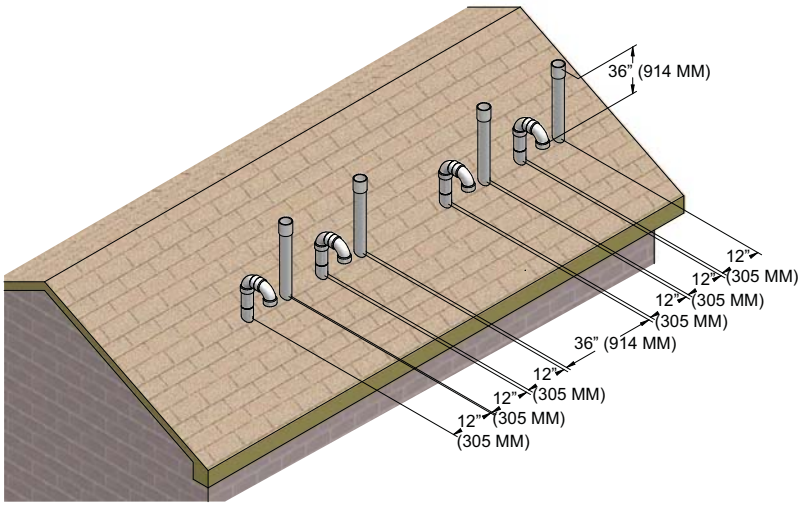
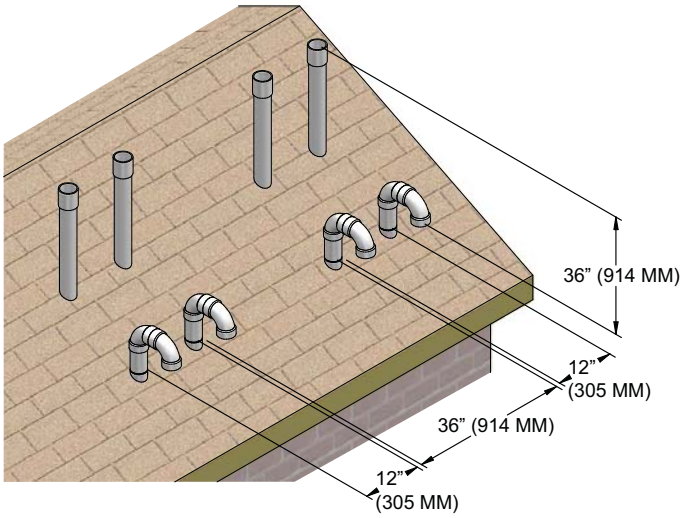


Figure 3-4 *Alternate Vertical Terminations with Multiple Boilers*



4 Sidewall direct venting

Vent/air termination – sidewall

⚠ WARNING Follow instructions below when determining vent location to avoid possibility of severe personal injury, death, or substantial property damage.

⚠ WARNING A gas vent extending through an exterior wall shall not terminate adjacent to a wall or below building extensions such as eaves, parapets, balconies, or decks. Failure to comply could result in severe personal injury, death, or substantial property damage.

⚠ WARNING Do not connect any other appliance to the vent pipe or multiple boilers to a common vent pipe except as noted in Section 2 on page 18. Failure to comply could result in severe personal injury, death, or substantial property damage.

⚠ CAUTION Sidewall venting commercial products will result in large exhaust plumes in cold climates. Consideration should be taken when locating in proximity to windows, doors, walkways, etc.

NOTICE Installation must comply with local requirements and with the National Fuel Gas Code, NFPA 54 / ANSI Z223.1 for U.S. installations or CSA B149.1 for Canadian installations.

Determine location

Locate the vent/air terminations using the following guidelines:

1. The total length of piping for vent or air must not exceed the limits given in the General Venting Section on page 17 of this manual.

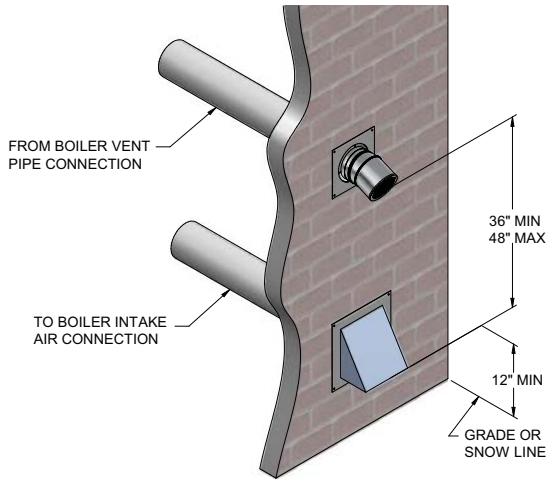
2. You must consider the surroundings when terminating the vent and air:
   a. Position the vent termination where vapors will not damage nearby shrubs, plants or air conditioning equipment or be objectionable.
   b. The flue products will form a noticeable plume as they condense in cold air. Avoid areas where the plume could obstruct window views.
   c. Prevailing winds could cause freezing of condensate and water/ice buildup where flue products impinge on building surfaces or plants.
   d. Avoid possibility of accidental contact of flue products with people or pets.
   e. Do not locate the terminations where wind eddies could affect performance or cause recirculation, such as inside building corners, near adjacent buildings or surfaces, window wells, stairwells, alcoves, courtyards, or other recessed areas.

⚠ WARNING Sidewall vent and air inlet terminations must terminate in the same pressure zone.

   f. Do not terminate above any door or above or below any window. Condensate can freeze, causing ice formations.
   g. Locate or guard vent to prevent condensate damage to exterior finishes.

Figure 4-1 *Sidewall Termination of Air and Vent*

NOTICE PVC/CPVC or ABS is acceptable air inlet pipe material.



3. Maintain clearances as shown in FIG.'s 4-1 thru 4-3, pages 21 and 22. The vent termination should not be located in traffic areas such as walkways, adjacent buildings, operable windows, or doors. Also maintain the following:
   a. Vent must terminate:
      • At least 6 feet (1.8 m) from adjacent walls.
      • Not less than 7 feet (2.1 m) above grade where located adjacent to public walkways.
      • No closer than 12 inches (305 mm) below roof overhang.
      • At least 3 feet (.9 m) above any forced air intake within 10 feet (3 m).
      • No closer than 4 feet (1.2 m) horizontally from any door or window or any other gravity air inlet.
   b. Air inlet must terminate at least 12 inches (305 m) above grade or snow line; at least 36 inches (914 mm) below the vent termination.
   c. Do not terminate closer than 4 feet (1.2 m) horizontally from any electric meter, gas meter, regulator, relief valve, or other equipment. Never terminate above or below any of these within 4 feet (1.2 m) horizontally.

4. Locate terminations so they are not likely to be damaged by foreign objects, such as stones or balls, or subject to buildup of leaves or sediment.

4 Sidewall direct venting

Vent/air termination – sidewall

Figure 4-2 *Clearance to Doors and Windows*

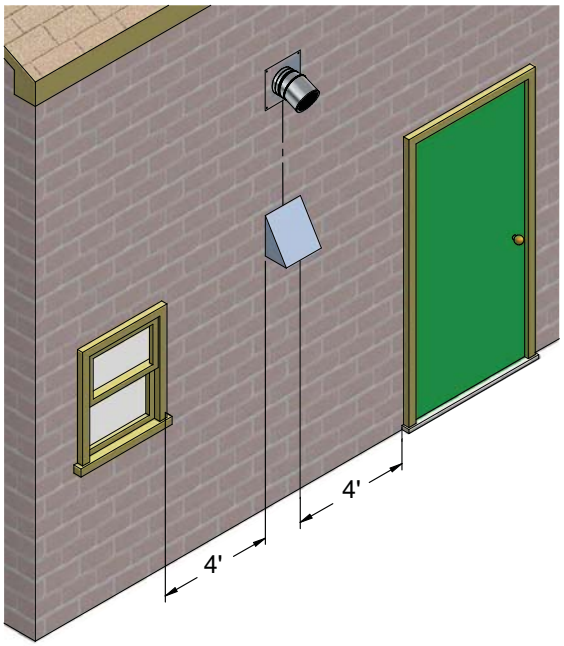
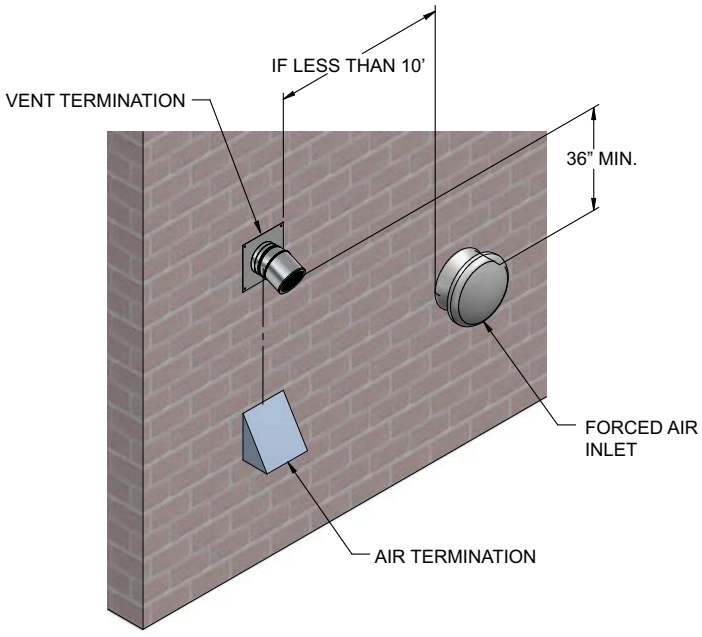


Figure 4-3 *Clearance to Forced Air Inlets*



⚠ CAUTION Sidewall venting commercial products will result in large exhaust plumes in cold climates. Consideration should be taken when locating in proximity to windows, doors, walkways, etc.

Prepare wall penetrations

1. Air pipe penetration:
   a. Cut a hole for the air pipe. Size the air pipe hole as close as desired to the air pipe outside diameter.

   Vent pipe penetration:
   a. Cut a hole for the vent pipe. For either combustible or noncombustible construction, size the vent pipe hole per the vent manufacturer's instructions.

2. Install the vent and air intake piping. Seal all gaps between the pipes and wall with RTV silicone sealant.
3. Seal all wall cavities.

Termination and fittings

1. The air termination must be oriented at least 12 inches above grade or snow line as shown in FIG. 4-1, page 21.
2. Maintain the required dimensions of the finished termination piping as shown in FIG. 4-1, page 21.
3. Do not extend exposed vent pipe outside of the building more than what is shown in this document. Condensate could freeze and block vent pipe.
4. Stainless steel terminations are designed to penetrate walls with a thickness up to 9.25 inches of standard construction.

Multiple vent/air terminations

1. When terminating multiple Crest boilers terminate each vent/air connection as described in this manual (FIG. 4-4).

⚠ WARNING All vent pipes and air inlets must terminate at the same height to avoid possibility of severe personal injury, death, or substantial property damage.

4 Sidewall direct venting *(continued)*

2. Place wall penetrations to obtain minimum clearance of 12 inches (305 mm) between vent pipe and adjacent air inlet, as shown in FIG. 4-4 for U.S. installations. For Canadian installations, provide clearances required by CSA B149.1 Installation Code.

3. The air inlet of a Crest is part of a direct vent connection. It is not classified as a forced air intake with regard to spacing from adjacent boiler vents.

Figure 4-4 *Multiple Vent Terminations (must also comply with* ***Figure 4-1****)*

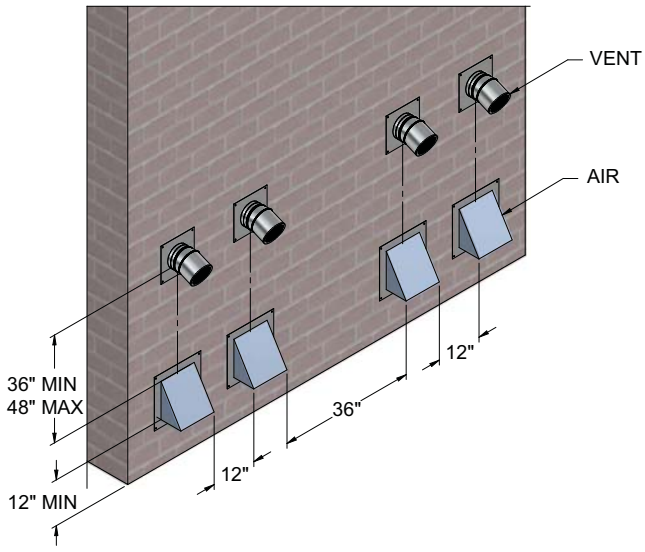


Figure 4-5 *Direct Vent Terminations*

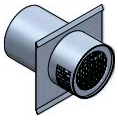
DIRECT VENT TERMINATIONS			
Air Inlet		Vent Termination	
Dryer Inlet		Straight	
90° Elbow		Mitered	
		23° Elbow	

Figure 4-6 *Room Air (Direct Exhaust Terminations)*

ROOM AIR (DIRECT EXHAUST TERMINATIONS)	
Vent Termination	
23° Elbow	
45° Elbow	
90° Elbow	

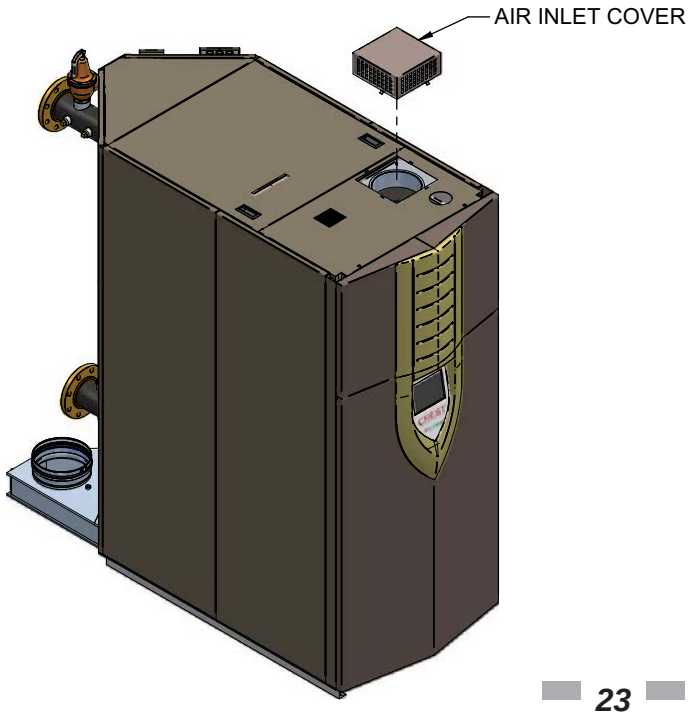
Room air

The Crest boiler may be installed with a single pipe carrying the flue products to the outside while using combustion air from the equipment room.

Follow the requirements in the General Venting, Sidewall Direct Venting, and Vertical Direct Venting sections for vent material specifications, vent length requirements, and vent termination requirements.

Install the air inlet cover (shipped loose with the boiler) per FIG. 4-7. Combustion and ventilation air must be supplied to the equipment room per the requirements on pages 12 and 13 of this manual for proper operation of the Crest boiler when utilizing the single pipe method.

Figure 4-7 *Room Air Installation*



5 Hydronic piping

System water piping methods

The Crest is designed to function in a closed loop pressurized system not less than 12 psi (83 kPa). A temperature and pressure gauge is included to monitor system pressure and outlet temperature and should be located on the boiler outlet.

It is important to note that the boiler has a pressure drop which must be figured in when sizing the circulators. Each boiler installation must have an air elimination device, which will remove air from the system.

Install the boiler so the gas ignition system components are protected from water (dripping, spraying, etc.) during appliance operation or basic service of circulator replacement, valves, and others.

Observe a minimum of 1/4 inch (6 mm) clearance around all uninsulated hot water pipes when openings around the pipes are not protected by non-combustible materials.

Low water cutoff device

An electronic low water cutoff is provided as standard equipment on all models. The low water cutoff should be inspected every 6 months.

Chilled water system

If the boiler supplies hot water to heating coils in air handler units, flow control valves or other devices must be installed to prevent gravity circulation of heater water in the coils during the cooling cycle. A chilled water medium must be piped in parallel with the heater.

Freeze protection

Freeze protection for new or existing systems must use glycol that is specially formulated for this purpose. This includes inhibitors, which prevent the glycol from attacking the metallic system components. Make certain to check that the system fluid is correct for the glycol concentration and inhibitor level. The system should be tested at least once a year and as recommended by the producer of the glycol solution. Allowance should be made for the expansion of the glycol solution in the system piping.

⚠ WARNING Use only inhibited propylene glycol solutions, which are specifically formulated for hydronic systems. Ethylene glycol is toxic and can attack gaskets and seals used in hydronic systems.

General piping information

Basic steps are listed below along with illustrations on the following pages, which will guide you through the installation of the Crest (5-2 thru 5-5).

1. Connect the system return to the 4" flanged connection marked “Inlet”, make sure to install with a suitable gasket between flanges.
2. Connect the system supply to the 4" flanged connection marked “Outlet”, make sure to install with a suitable gasket between flanges.
3. Install purge and balance valve or shutoff valve and drain on system return to purge air out of each zone.
4. Install a backflow preventer on the cold feed make-up water line.
5. Install a pressure reducing valve on the cold feed make-up water line, (15 psi (103 kPa) nominal). Check temperature and pressure gauge, which should read a minimum pressure of 12 psi (83 kPa).
6. Install the circulators as shown on the piping diagrams in this section. Make sure the circulators are properly sized for the system and friction loss. Install check valves with each boiler circulator.
7. Install an expansion tank on the system supply. Consult the tank manufacturer’s instruction for specific information relating to tank installation. Size the expansion tank for the required system volume and capacity.
8. Install an air elimination device on the system supply.
9. This appliance is supplied with a relief valve sized in accordance with ASME Boiler and Pressure Vessel Code, Section IV (“Heating Boilers”). The safety relief valve is installed at the factory and is located on the rear of the boiler. Pipe the discharge of the safety relief valve to prevent injury in the event of pressure relief. Pipe the discharge to a drain. Provide piping that is the same size as the safety relief valve outlet. Never block the outlet of the safety relief valve.
10. On any pre-existing system, it is good practice to install a field supplied strainer to prevent damage to the heat exchanger.

See the piping illustrations included in this section, FIG.’s 5-2 thru 5-5 for suggested guidelines in piping the Crest.

NOTICE Please note that these illustrations are meant to show system piping concept only, the installer is responsible for all equipment and detailing required by local codes.

5 Hydronic piping *(continued)*

Circulator sizing

The Crest heat exchanger does have a pressure drop, which must be considered in your system design. Refer to the graph in FIG. 5-1 for pressure drop through the Crest heat exchanger.

Figure 5-1 *Pressure Drop vs. Flow*

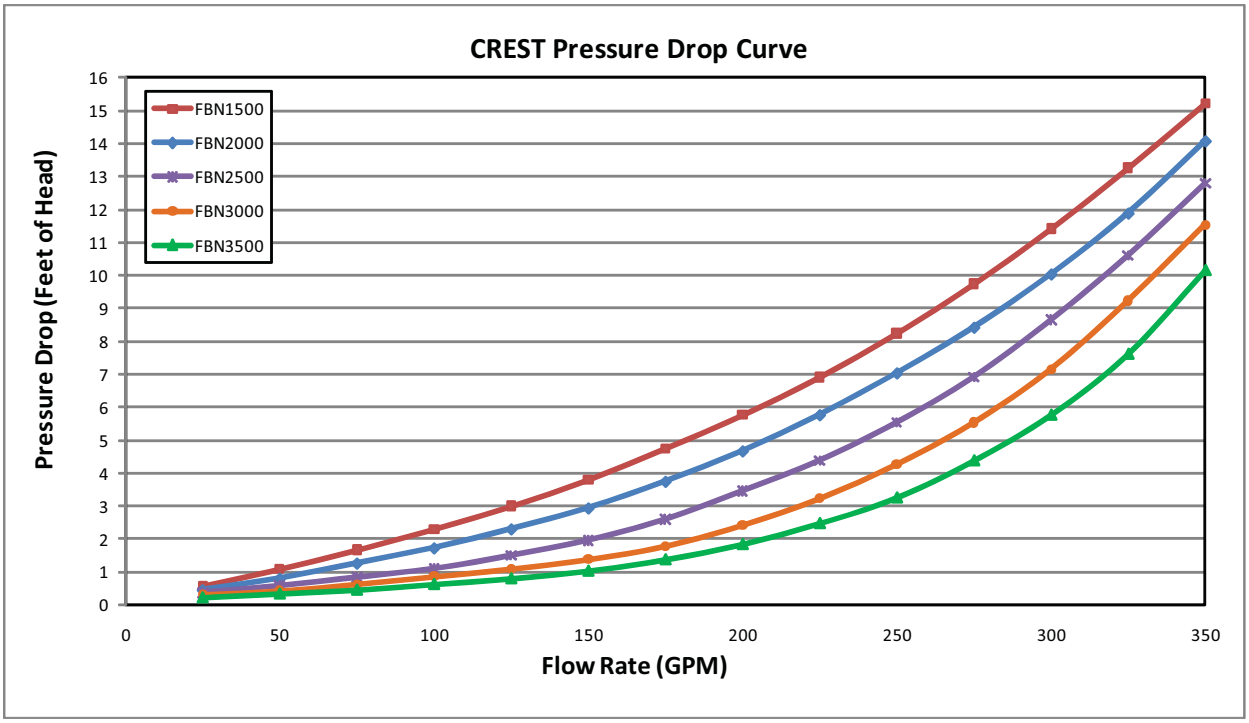


Table 5A *Sizing Information for Temperature Rise Applications_20°F, 40°F and 60°F*

TEMPERATURE RISE APPLICATIONS							
Model	BOILER CONNECTION SIZE	20°F		40°F		60°F	
		GPM	FT/HD	GPM	FT/HD	GPM	FT/HD
FB 1500	4"	138	3.4	69	1.5	46	1.0
FB 2000	4"	184	4.1	92	1.6	61	1.0
FB 2500	4"	230	4.6	115	1.3	77	0.7
FB 3000	4"	277	5.6	138	1.2	92	0.7
FB 3500	4"	323	7.5	161	1.2	108	0.7
[Based on 92% AHRI Efficiency]							

NOTICE The pressure drop reflected in FIG. 5-1 is for the **boiler only**. Additional allowances must be made for piping, especially if sizing pumps for Primary/Secondary applications.

NOTICE It is required that boiler piping systems utilize *Primary/Secondary or Fixed or Variable Flow Primary* configurations as shown in FIG.'s 5-2 thru 5-5. The use of other boiler piping configurations could result in improper building and system flow rates leading to inadvertent boiler high limit shutdowns and poor system performance.

5 Hydronic piping

Near boiler piping components

1. **Boiler piping:**
   Boiler system piping should be sized per the pipe requirements listed in Tables 5A and 5C.

2. **Boiler circulating pump:**
   Field supplied. When using Primary/Secondary piping the boiler circulating pump should be sized per Table 5A.

3. **Hot Water Generator circulating pump:**
   Field supplied. When installed in a Primary/Secondary arrangement, the Crest requires an additional pump for the Hot Water Generator Loop. The pump should be sized per Table 5A. Consult the indirect water heater operating guide to determine flow characteristics for the selected product used. The pump's total flow and heat requirements are the sum of the boiler and the indirect water heater.

4. **Boiler isolation valves:**
   Field supplied. Full port valves are required. Failure to use full port valves could result in a restricted flow rate through the boiler.

5. **Check valves:**
   Field supplied. Check valves are required for installation as shown in FIG.'s 5-2 and 5-3. Failure to install check valves could result in a reverse flow condition during pump(s) off cycle.

6. **Domestic indirect hot water isolation valves:**
   Field supplied. Full port valves are required. Failure to use full port valves could result in a restricted flow rate through the boiler.

7. **Anti-scald mixing valve:**
   Field supplied. An anti-scald mixing valve is recommended when storing domestic hot water above 115°F (46°C).

8. **Pressure relief valve:**
   Factory supplied. The pressure relief valve is sized to ASME specifications.

9. **System temperature sensor:**
   Lochinvar supplies a system temperature sensor. The sensor is to be installed in the heating loop downstream from the boiler hot water piping and heating loop junction. The sensor should be located far enough downstream to sense system diluted water temperature.

NOTICE A system supply sensor (factory supplied) MUST BE installed with Primary/Secondary systems for proper boiler operation.

10. **Y-Strainer:**
    Field supplied. A Y-strainer or equivalent multipurpose strainer is recommended at the inlet of the heat exchanger to remove system particles from older hydronic systems and protect newer systems.

⚠ CAUTION The maximum allowable water flow rate through a single Crest boiler is 350 GPM. Exceeding this flow rate will result in damage to the heat exchanger and/or piping.

NOTICE Reference Table 5B1 for the minimum recommended flow rate through a single Crest boiler at full fire to maintain a 80°F temperature rise. Reference Table 5B2 for the absolute minimum flow rate through a single Crest boiler.

Table 5B1 *Minimum Flow Rate with the Boiler at Full Fire*

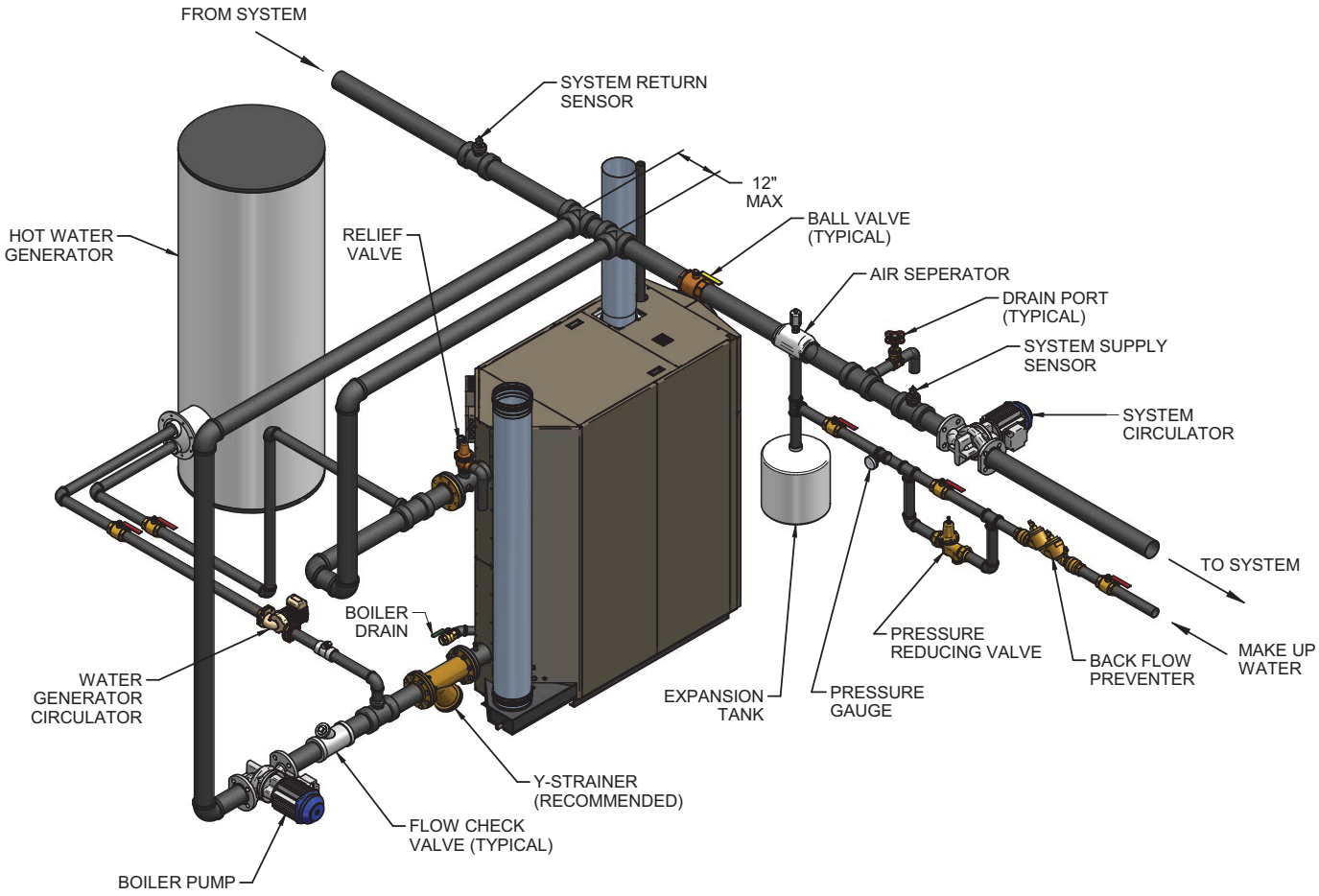
TEMPERATURE RISE APPLICATIONS	
MODEL	**FLOW RATE (GPM)**
FB(N,L)1500	35
FB(N,L)2000	46
FB(N,L)2500	58
FB(N,L)3000	70
FB(N,L)3500	81
[Based on 80°F Temperature Rise]	

Table 5B2 *Absolute Minimum Flow Rate*

ABSOLUTE MINIMUM FLOW RATE	
MODEL	**FLOW RATE (GPM)**
FB(N,L)1500	25
FB(N,L)2000	25
FB(N,L)2500	25
FB(N,L)3000	25
FB(N,L)3500	45

5 Hydronic piping *(continued)*

Figure 5-2 *Single Boiler - Recommended - Primary / Secondary Piping with a Hot Water Generator*



NOTICE System flow should always remain higher than the required flow for the boiler(s) when the boiler(s) is in operation to prevent short cycling and high limit issues.

NOTICE Please note that these illustrations are meant to show system piping concept only, the installer is responsible for all equipment and detailing required by local codes.

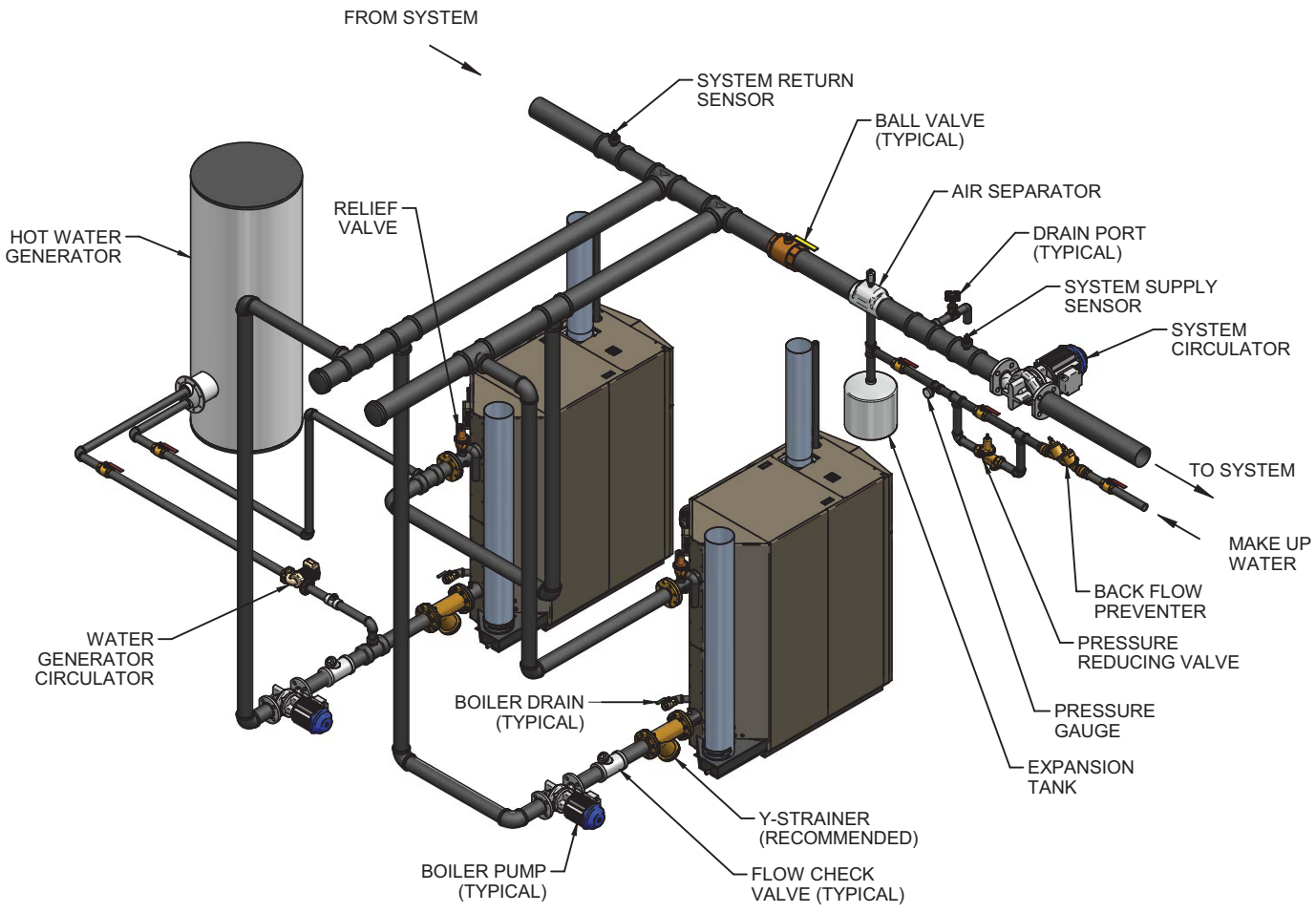
5 Hydronic piping

Table 5C *Multiple Boilers - Common Header - Primary / Secondary Flow*

Model	Number of Units						
	2	3	4	5	6	7	8
	Recommended Common Header Pipe Sizes in Inches						
FB 1500	4	4	5	5	6	6	7
FB 2000	4	5	5	6	7	7	8
FB 2500	5	5	6	7	7	8	10
FB 3000	5	6	7	7	8	10	10
FB 3500	5	6	7	8	10	10	10
[Based on a boiler ΔT of 30°F.]							

NOTICE A system supply sensor (factory supplied) MUST BE installed for proper boiler operation.

Figure 5-3 *Multiple Boilers - Common Header - Recommended - Primary / Secondary Flow*

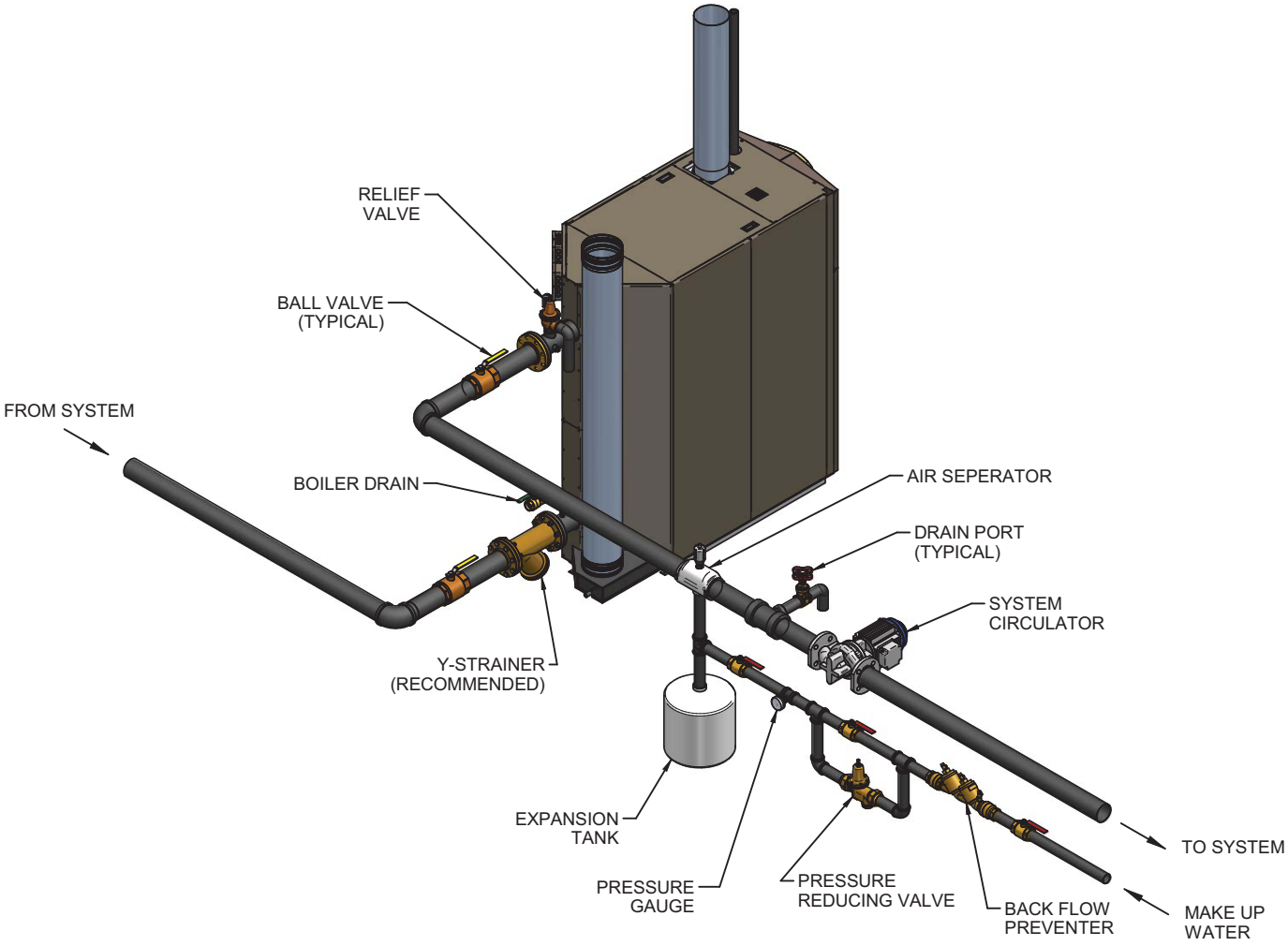


NOTICE System flow should always remain higher than the required flow for the boiler(s) when the boiler(s) is in operation to prevent short cycling and high limit issues.

NOTICE Please note that these illustrations are meant to show system piping concept only, the installer is responsible for all equipment and detailing required by local codes.

5 Hydronic piping *(continued)*

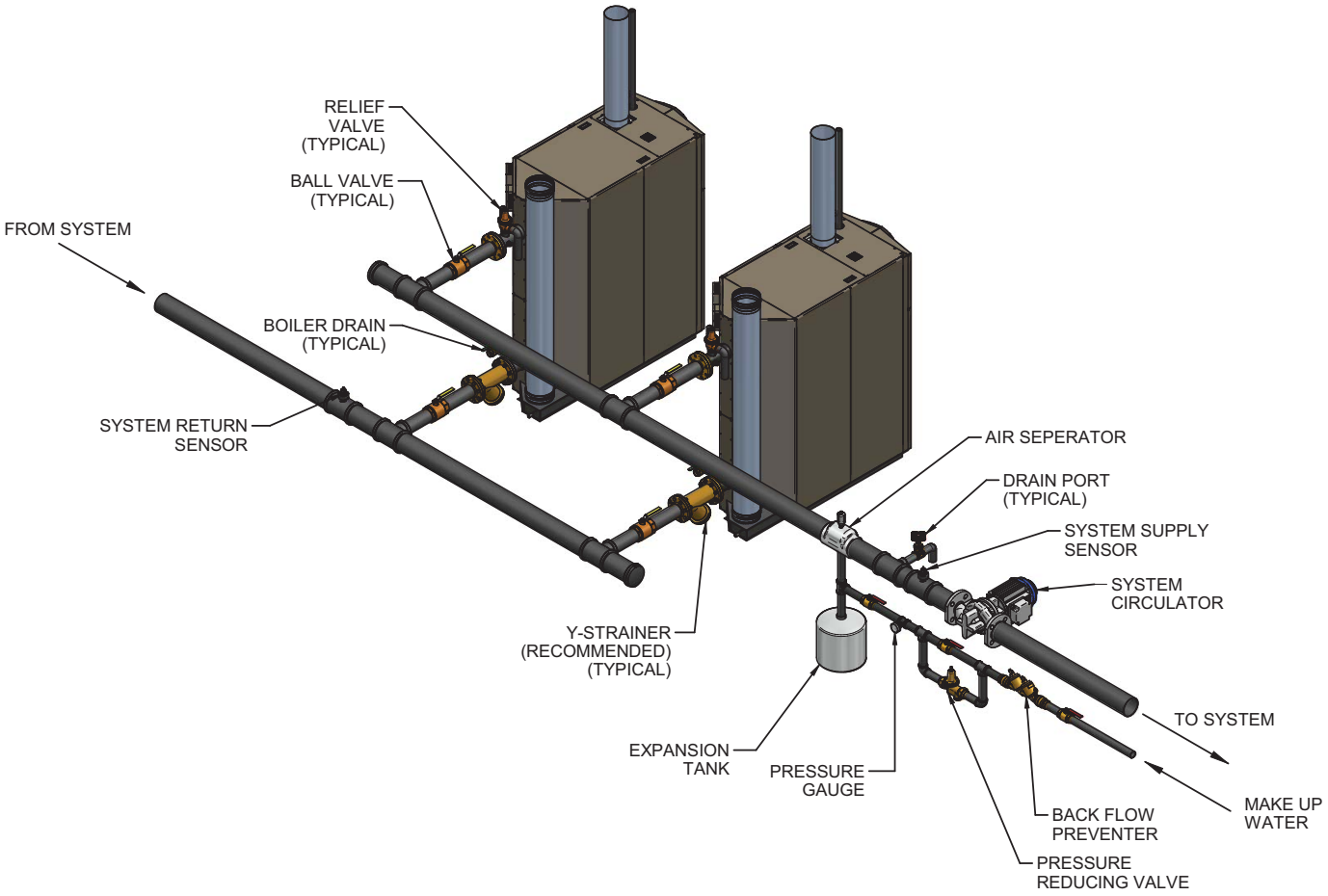
Figure 5-4 *Single Boiler - Alternate - Fixed or Variable Flow Primary System Piping*



NOTICE Please note that these illustrations are meant to show system piping concept only, the installer is responsible for all equipment and detailing required by local codes.

5 Hydronic piping

Figure 5-5 *Multiple Boilers - Alternate - Common Header - Fixed or Variable Flow Primary*



NOTICE Please note that these illustrations are meant to show system piping concept only, the installer is responsible for all equipment and detailing required by local codes.

NOTICE When installing multiple Crest boilers in fixed or variable flow primary applications, utilize a reverse-return or other piping method to ensure balanced flow through each boiler.

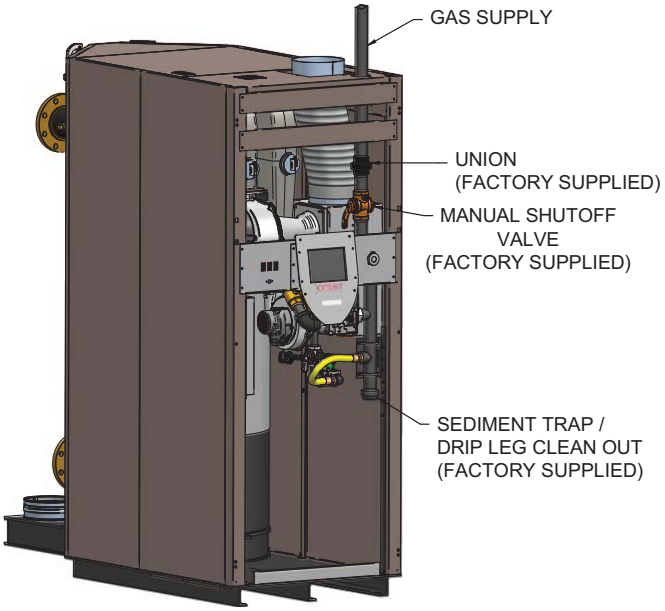
6 Gas connections

Connecting gas supply piping

NOTICE For dual fuel models, reference the Crest Dual Fuel Supplemental Manual.

1. Refer to FIG. 6-1 to pipe gas to the boiler.
   a. Install ground joint union for servicing, when required.
   b. In Canada – When using manual main shutoff valves, it must be identified by the installer.

Figure 6-1 *Gas Supply Piping*



2. Support piping with hangers, not by the boiler or its accessories.

⚠ WARNING The gas valve and blower will not support the weight of the piping. Do not attempt to support the weight of the piping with the boiler or its accessories. Failure to comply could result in severe personal injury, death, or substantial property damage.

3. Purge all air from the gas supply piping.

4. Before placing the boiler in operation, check the boiler and its gas connection for leaks.
   a. The appliance must be disconnected from the gas supply piping system during any pressure testing of that system at a test pressure in excess of 1/2 PSIG (3.5 kPa).
   b. The appliance must be isolated from the gas supply piping system by closing a manual shutoff valve during any pressure testing of the gas supply piping system at test pressures equal to or less than 1/2 PSIG (3.5 kPa).
   c. The appliance and its gas connection must be leak tested before placing it in operation.

⚠ WARNING Do not check for gas leaks with an open flame – use the bubble test. Failure to use the bubble test or check for gas leaks can cause severe personal injury, death, or substantial property damage.

5. Use pipe sealing compound compatible with propane gases. Apply sparingly only to male threads of the pipe joints so that pipe dope does not block gas flow.

⚠ WARNING Failure to apply pipe sealing compound as detailed in this manual can result in severe personal injury, death, or substantial property damage.

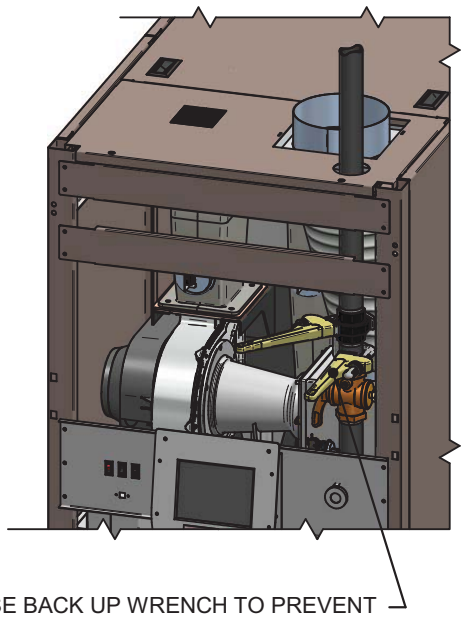
Table 6A *Gas Inlet Size*

Model	Gas Inlet Size
FB1500	1 1/2"
FB2000	1 1/2"
FB2500	2"
FB3000	2"
FB3500	2"

6 Gas connections

⚠ WARNING Use two wrenches when tightening gas piping at boiler (FIG. 6-2), using one wrench to prevent the boiler gas line connection from turning. Failure to support the boiler gas connection pipe to prevent it from turning could damage gas line components.

Figure 6-2 *Inlet Pipe with Backup Wrench*



NOTICE Maximum inlet gas pressure must not exceed the value specified. Minimum value listed is for the purposes of input adjustment.

Natural gas:

⚠ WARNING Check boiler rating plate to determine which fuel the boiler is set for. Crest boilers CANNOT be field converted. Failure to comply could result in severe personal injury, death, or substantial property damage.

Pipe sizing for natural gas

1. Refer to Table 6B for pipe length and diameter. Based on rated boiler input (divide by 1,000 to obtain cubic feet per hour).
   a. Table 6B is only for natural gas with specific gravity 0.60 inches, with a pressure drop through the gas piping of 0.5 inches w.c.
   b. For additional gas pipe sizing information, refer to the National Fuel Gas Code, NFPA 54 / ANSI Z223.1 - latest edition, or in Canada CSA B149.1 Installation Code.

Natural gas supply pressure requirements

1. Pressure required at the gas valve inlet pressure port:
   • Maximum 14 inches w.c. (3.5 kPa) with no flow (lockup) or with boiler on.
   • Minimum 4 inches w.c. (.99 kPa) with gas flowing (verify during boiler startup).
2. Install 100% lockup gas pressure regulator in supply line if inlet pressure can exceed 14 inches w.c. (3.5 kPa) at any time. Adjust lockup regulator for 14 inches w.c. (3.5 kPa) maximum.

⚠ WARNING Ensure that the high gas pressure regulator is at least 10 feet (3 m) upstream of the appliance.

Propane Gas:

⚠ WARNING Check boiler rating plate to determine which fuel the boiler is set for. Crest boilers CAN NOT be field converted. Failure to comply could result in severe personal injury, death, or substantial property damage.

Pipe sizing for propane gas

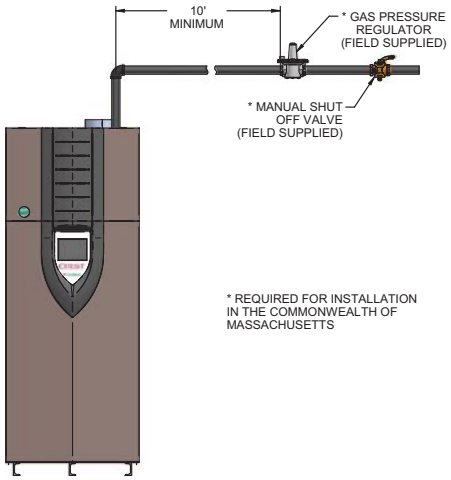
1. Contact gas supplier to size pipes, tanks, and 100% lockup gas pressure regulator.

Propane Supply Pressure Requirements

1. Adjust propane supply regulator provided by the gas supplier for 14 inches w.c. (3.5 kPa) maximum pressure.
2. Pressure required at gas valve inlet pressure port:
   • Maximum 14 inches w.c. (3.5 kPa)with no flow (lockup) or with boiler on.
   • Minimum 4 inches w.c. (.99 kPa) with gas flowing (verify during boiler startup).

⚠ WARNING Ensure that the high gas pressure regulator is at least 10 feet (3 m) upstream of the appliance (FIG. 6-3).

Figure 6-3 *Gas Supply Piping to Regulator*



6 Gas connections *(continued)*

Table 6B *Natural Gas Pipe Size Chart*

TABLE - 6B
GAS PIPING SIZE CHART

Nominal Iron Pipe Size Inches	Length of Pipe in Straight Feet														Maximum Capacity of Pipe in Thousands of Btu/hr for gas pressures of 14 Inches Water Column (0.5 PSIG) or less and a pressure drop of 0.5 Inch Water Column (Based on NAT GAS, 1025 Btu/hr per Cubic Foot of Gas and 0.60 Specific Gravity)
	10	20	30	40	50	60	70	80	90	100	125	150	175	200	
1½	2,150	1,500	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
2	4,100	2,820	2,260	1,950	1,720	1,560	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
2½	6,460	4,460	3,610	3,100	2,720	2,460	2,310	2,100	2,000	1,900	1,700	1,540	N/A	N/A	
3	11,200	7,900	6,400	5,400	4,870	4,410	4,000	3,800	3,540	3,300	3,000	2,720	2,500	2,340	
4	23,500	16,100	13,100	11,100	10,000	9,000	8,300	7,690	7,380	6,870	6,150	5,640	5,130	4,720	

Check inlet gas supply

⚠ WARNING DO NOT adjust or attempt to measure gas valve outlet pressure. Attempting to alter or measure the gas valve outlet pressure could result in damage to the valve, causing potential severe personal injury, death, or substantial property damage.

The gas piping must be sized for the proper flow and length of pipe, to avoid excessive pressure drop. Both the gas meter and the gas regulator must be properly sized for the total gas load.

If you experience a pressure drop greater than 1 inch w.c. (249 Pa), the meter, regulator, or gas line is undersized or in need of service. Perform the steps below when checking inlet gas supply:

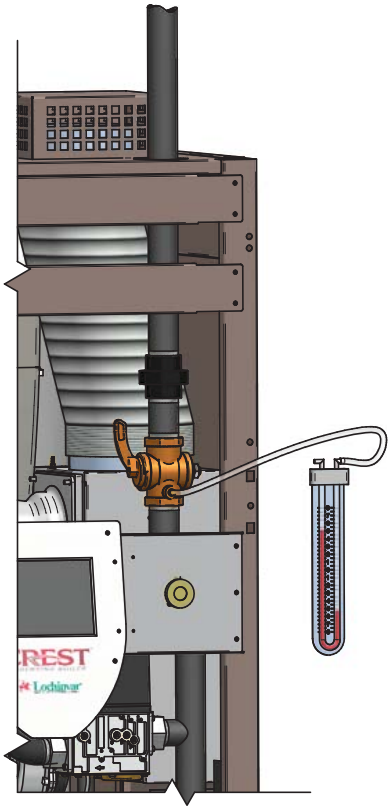
1. Turn the main power switch to the "OFF" position.
2. Shut off gas supply at the manual gas valve in the gas piping to the appliance.
3. Remove the 1/8" pipe plug on the flange to the factory supplied gas shutoff valve and install a suitable 1/8" fitting (field supplied) for the manometer tubing. Place the tubing of the manometer over the tap once the 1/8" fitting is installed as shown in FIG. 6-4.
4. Slowly turn on the gas supply at the factory installed manual gas valve.
5. Turn the power switch to the "ON" position.
6. Adjust the temperature set point on the control panel of the SMART TOUCH control module to call for heat or utilize Service Mode, see page 44 of this manual.
7. Observe the gas supply pressure as the burner fires at 100% of rated input. Percent of burner input will be displayed on the Modulation Screen.
8. Ensure inlet pressure is within specified range. Minimum and maximum gas supply pressures are specified in this section of the manual.
9. If gas supply pressure is within normal range and no adjustments are needed, proceed on to Step 11.
10. If the gas pressure is out of range, contact the gas utility, gas supplier, qualified installer or service agency to determine the necessary steps to provide proper gas pressure to the control.
11. Turn the power switch to the "OFF" position.
12. Shut off the gas supply at the manual gas valve in the gas piping to the appliance.
13. Remove the manometer from the pressure tap on top of the gas valve. Remove the 1/8" (3 mm) field supplied fitting and reinstall the pipe plug removed in Step 3.

6 Gas connections

⚠ WARNING Do not check for gas leaks with an open flame -- use the bubble test. Failure to use the bubble test or check for gas leaks can cause severe personal injury, death, or substantial property damage.

14. Turn on the gas supply at the manual gas valve.
15. Turn the power switch to the "ON" position.
16. Adjust the temperature set point on the control panel of the SMART TOUCH control module to the desired water temperature so the appliance will call for heat.
17. Check burner performance by cycling the system while you observe burner response. The burner should ignite promptly. Flame pattern should be stable. Turn system off and allow burner to cool, then cycle burner again to ensure proper ignition and flame characteristics.

Figure 6-4 *Inlet Gas Supply Check*



Gas Pressure

The gas pressure must remain between 4 inches w.c. (.99 kPa) minimum and 14 inches w.c. (3.5 kPa) maximum for Natural gas and between 4 inches w.c. (.99 kPa) minimum and 14 inches w.c. (3.5 kPa) maximum for LP gas during standby (static) mode and while in operating (dynamic) mode. If an in-line regulator is used, it must be a minimum of 10 feet (3 m) from the Crest boiler. It is very important that the gas line is properly purged by the gas supplier or utility company. Failure to properly purge the lines or improper line sizing, will result in ignition failure.

Ignition problems are especially noticeable in NEW LP installations and also in empty tank situations. This can also occur when a utility company shuts off service to an area to provide maintenance to their lines.

Gas valve replacement

The gas valve MUST NOT be replaced with a conventional gas valve under any circumstances. As an additional safety feature, the gas valves have flanged connections to the venturis and blowers.

⚠ WARNING Failure to follow all precautions could result in fire, explosion, or death!

⚠ WARNING DO NOT adjust or attempt to measure gas valve outlet pressure. Attempting to alter or measure the gas valve outlet pressure could result in damage to the valve, causing potential severe personal injury, death, or substantial property damage.

7 Field wiring

⚠ WARNING ELECTRICAL SHOCK HAZARD – For your safety, turn off electrical power supply before making any electrical connections to avoid possible electric shock hazard. Failure to do so can cause severe personal injury or death.

NOTICE Wiring must be N.E.C. Class 1.

If original wiring as supplied with boiler must be replaced, use only type 105°C wire or equivalent.

Boiler must be electrically grounded as required by National Electrical Code ANSI/NFPA 70 – latest edition.

⚠ CAUTION Label all wires prior to disconnection when servicing controls. Wiring errors can cause improper and dangerous operation.

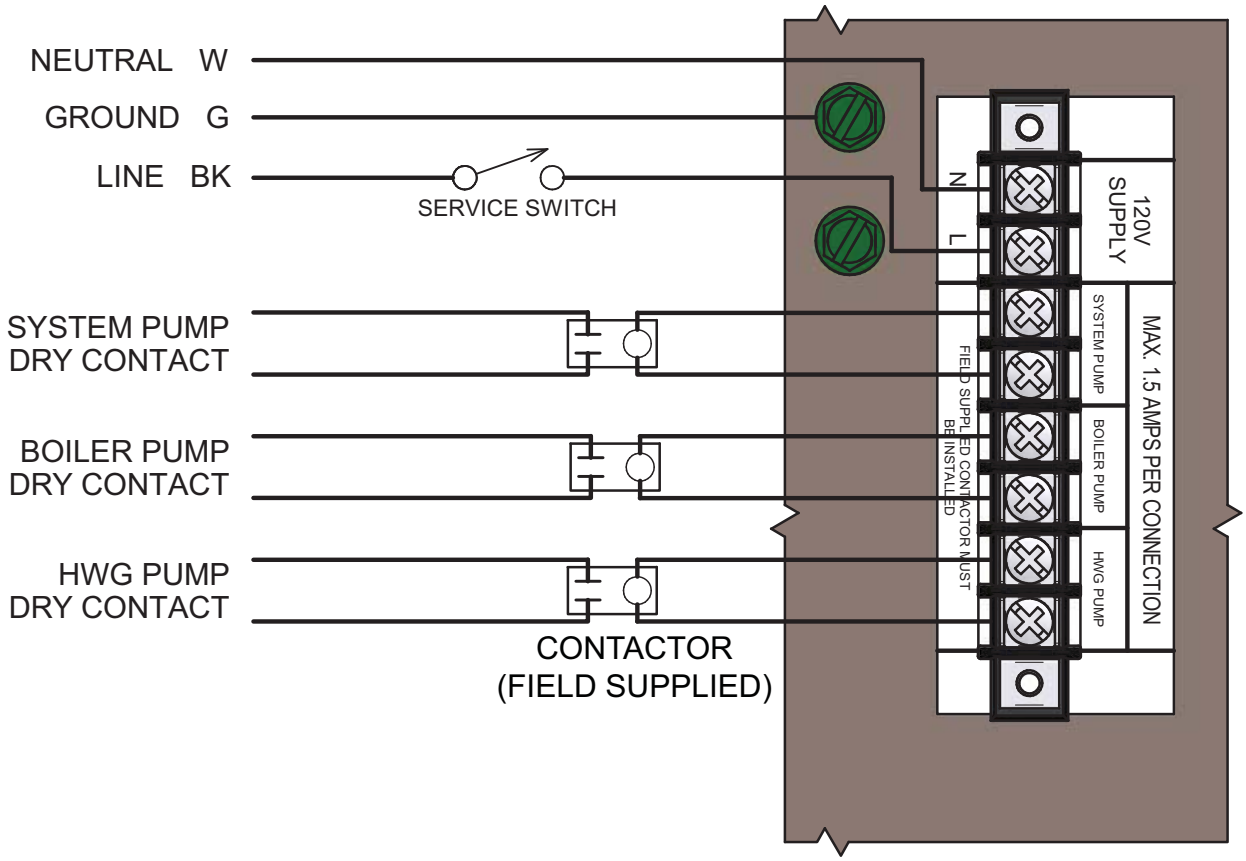
Installation must comply with:

1. National Electrical Code and any other national, state, provincial, or local codes, or regulations.
2. In Canada, CSA C22.1 Canadian Electrical Code Part 1, and any local codes.

Line voltage connections

1. Connect 120 VAC power wiring to the line voltage terminal strip in the junction box, as shown in FIG. 7-1.
2. Provide and install a fused disconnect or service switch sized per the boiler amp draw (shown on the boiler rating plate) as required by the code (see FIG. 7-1).
3. When connecting the boiler, system and hot water generator pumps connect the wiring to the line voltage terminal strip as shown in FIG. 7-1. Maximum current is 1.5 amps. Install a field supplied contactor between the pump(s) and the boiler connections.
4. For alternate voltages, consult factory.

***Figure 7-1 Boiler** Line Voltage Field Wiring Connections*

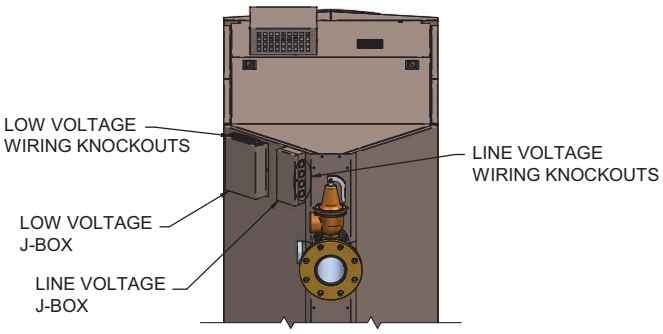


7 Field wiring

Low voltage connections

1. Route all low voltage wires through the knockouts in the rear of the boiler, as shown in FIG. 7-2.
2. Connect low voltage wiring to low voltage connection board as shown in FIG. 7-3 on page 38 of this manual and the boiler wiring diagram.

Figure 7-2 *Routing Field Wiring*



Enable

1. Connect the room thermostat or boiler enable contacts (isolated contact only) to terminals 7 and 8, as shown in FIG. 7-3.
2. If a thermostat is used, install the thermostat on the inside wall away from influences of drafts, hot or cold water pipes, lighting fixtures, television, sunlight, or fireplaces.
3. Thermostat anticipator (if applicable):
   a. If connected directly to boiler, set for 0.1 amps.
   b. If connected to relays or other devices, set to match total electrical power requirements of connected devices. See device manufacturers' specifications and thermostat instructions for details.

Outdoor temperature sensor

1. Connect the outdoor temperature sensor (FIG. 7-3) to the Outdoor Sensor terminals on the connection board to enable outdoor reset operation of the Crest.
2. Mount the sensor on an exterior wall, shielded from direct sunlight or flow of heat or cooling from other sources.
3. Route sensor wires through a knockout at the rear of the boiler (see FIG. 7-2).

Variable speed system pump

If a variable speed pump is used in the primary loop, and a 0-10V signal is available from the pump speed control, this signal can be used by the SMART TOUCH control to anticipate changes in the building heat load. By connecting this 0 - 10V signal to the 0 - 10V SYS PUMP IN terminals, the boiler (or cascade) can modulate up and down as the primary flow increases and decreases.

ModBus

The RS-485 ModBus cable is connected to the ModBus terminals. Use shielded, 2-wire twisted pair cable. If desired, the shield can be connected to ground by installing a jumper wire between terminals 1 and 3 on connector X5 on the ModBus interface module.

Hot Water Generator (HWG) thermostat

1. Connect the HWG tank thermostat to the Tank Thermostat terminals on the connection board (FIG. 7-3).

Hot Water Generator (HWG) tank sensor

1. By installing a HWG tank sensor, the SMART TOUCH control can perform the tank thermostat function. The SMART TOUCH control automatically detects the presence of this sensor, and generates a HWG call for heat when the tank temperature drops 6°F (3°C) below the tank set point, and finishes the call for heat when the tank temperature reaches the tank set point.
2. A TST20015 sensor MUST be used with any indirect tank. Failure to use the correct sensor will result in the tank temperature being either above or below the set point. Connect the correct sensor to the Tank Sensor terminals (see FIG. 7-3).

Louver relay

If louvers need to operate before the boiler fires, they can be controlled by this output. Connect these terminals to a 24V relay coil, which is wired to operate the louvers (FIG. 7-3).

Louver proving switch

Louvers are used to provide combustion air for the room air option. A louver proving switch should be connected to the appropriate terminals and are verified prior to operation (see FIG. 7-3).

Boiler pump speed output

This 0 - 10V output is available to control the speed of a variable speed boiler pump. The SMART TOUCH control will vary the speed of this pump in order to maintain a minimum ΔT (set by the installer, see the Crest Service Manual) across the heat exchanger, as well as prevent high limit lockouts when the flow in the primary loop is extremely low. Connect this output to the 0 - 10V input on the boiler pump speed control.

NOTICE A system supply sensor must be installed for this feature to work.

Rate output

This output provides a 0 - 10V signal that is proportional to the firing rate of the boiler. This may be used by a BMS system to monitor the actual rate of the boiler.

7 Field wiring *(continued)*

Auxiliary switch 1 & 2

Additional field supplied limit controls may be connected to the auxiliary switch inputs. If additional limit controls fail or open, it will result in a manual reset lockout.

System supply sensor

1. By installing the system supply sensor into the supply of the primary loop, the temperature of the system supply can be controlled. The SMART TOUCH control automatically detects the presence of this sensor, and controls the boiler firing rate to maintain the system supply temperature to the set point.

NOTICE DO NOT INSTALL THE SYSTEM SUPPLY SENSOR INTO THE SYSTEM RETURN.

2. For system supply sensor wiring information reference (FIG. 7-3).

NOTICE Unless a firing rate is being provided by a BMS system, a system supply sensor (factory supplied) MUST BE installed with Primary/Secondary piping systems for proper boiler operation.

Boiler management system

1. An external control may be connected to control either the firing rate or the set point of the boiler. Connect the 0 - 10 VDC terminals to the 0 - 10 VDC output of the external control. The SMART TOUCH control can be enabled using the Enable output (see page 38) or using the voltage applied to the 0 - 10 VDC input. Reference the Crest Service Manual for more details.

2. Make sure terminal #34 on the Low Voltage Connection Board is connected to the (-) or COM output terminal of the external control, and 0 - 10 VDC terminal #33 is connected to the 0 - 10 VDC terminal of the external control.

Runtime contacts

The SMART TOUCH control closes a set of dry contacts whenever the burner is running. This is typically used by Building Management Systems to verify that the boiler is responding to a call for heat.

Alarm contacts

The SMART TOUCH control closes another set of contacts whenever the boiler is locked out or the power is turned off. This can be used to turn on an alarm, or signal a Building Management System that the boiler is down.

System return sensor

1. Install the system return sensor into the return of the primary loop.
2. Connect the terminals to the system return sensor as shown in FIG. 7-3.

Wiring of the cascade

When wiring the boilers for Cascade operation, select one boiler as the Leader boiler. The remaining boilers will be designated as Members. See page 45 “Configuration of the Cascade” for a detailed explanation of this procedure.

Connect the system supply sensor, system return sensor and outdoor air sensor (if used) to the Leader boiler.

NOTICE Unless a firing rate is being provided by a BMS system, a system supply sensor (factory supplied) MUST BE installed with Primary/Secondary piping systems for proper boiler operation.

The location of the system supply sensor should be downstream of the boiler connections in the main system loop (FIG.’s 5-5 and 5-6). The system supply sensor should be wired to the Low Voltage Connection Board at the terminals marked for the system supply sensor (see FIG. 7-3). The Leader control will use the water temperature at the system supply sensor to control the operation of the Cascade.

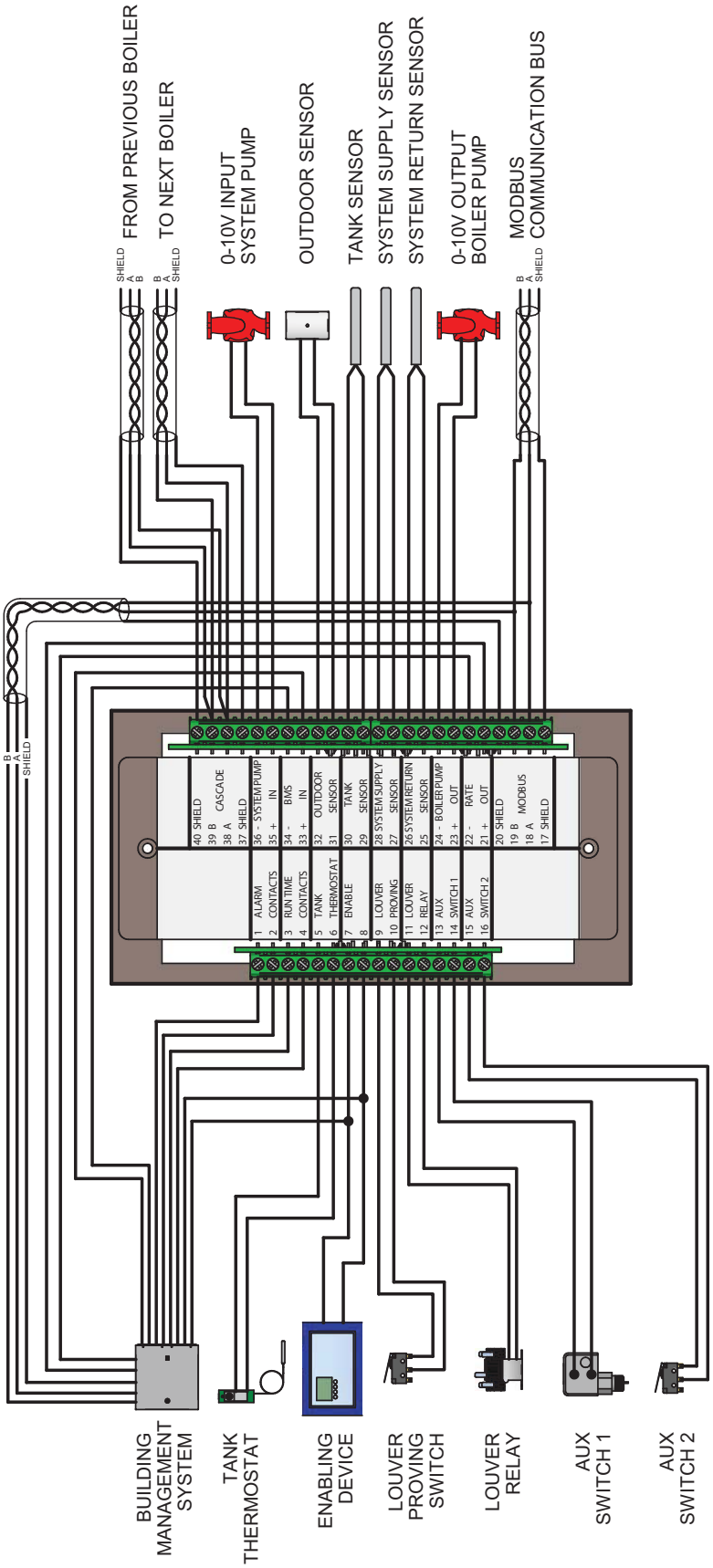
If outdoor air reset is desired, the outdoor air sensor should be wired to the Low Voltage Connection Board at the terminals marked for the outdoor air sensor on the Leader boiler (FIG. 7-3). If the outdoor air sensor is connected, the Leader control will calculate the water temperature set point based on the programmed reset curve parameters. If the outdoor air sensor is not connected, the Leader control will maintain the fixed water temperature set point that is programmed into the control.

If a Thermostat enable output is available, it should be wired to the Low Voltage Connection Board on the Leader boiler at the terminals marked Enable (FIG. 7-3). If the boilers are to run continuously, connect a jumper wire between the 7 and 8 terminals at the Enable input. This will initiate a call for heat on the Cascade. If the SMART TOUCH control is being controlled by a Boiler Management System (BMS), a call for heat may be initiated by the voltage applied to the BMS 0 - 10 VDC input instead.

Communication between the Leader boiler and the Member boilers is accomplished by using shielded, 2-wire twisted pair communication cable. Connect one of the twisted pair wires to Cascade terminal A on each of the Low Voltage Connection boards, and the other wire of the twisted pair to Cascade terminal B on each of the Low Voltage Connection Boards. Connect the shield wires to one of the Cascade shield ground terminals on the Low Voltage Connection Boards (FIG. 7-3). If more than two boilers are on the Cascade, daisy chain the wiring from the Cascade terminals on the second boiler to the Cascade terminals on the third boiler, then from the third to the forth, and so on. The connections between boilers can be made in any order, regardless of the addresses of the boilers. Try to keep each cable as short as possible.

7 Field wiring

Figure 7-3 *Low Voltage Field Wiring Connections*



8 Condensate disposal

Condensate drain

1. The Crest is a high efficiency appliance that produces condensate.
2. The rear of the boiler has a 1 inch (25.4 mm) stainless steel drain fitting and a 3/8 inch (9.8 mm) stainless steel vent line for connection to the condensate trap.
3. Connect the 1 inch (25.4 mm) fitting to the 1 inch (25.4 mm) fitting on the condensate trap with the factory supplied silicone hose. Secure the hose to the condensate trap and the boiler using the factory supplied hose clamps.
4. Connect the 3/8 inch (9.8 mm) fitting to the 3/8 inch (9.8 mm) fitting on the condensate trap (shipped loose) with the factory supplied silicone hose. Secure the hose to the condensate trap and the boiler using the factory supplied hose clamps.
5. The condensate trap must be installed at the same level or below the boiler base.
6. The condensate trap is sized for a 1" PVC outlet connection pipe.
7. Plug the wiring connection from the condensate trap into the connector located on the back of the unit.
8. Slope condensate tubing down and away from the boiler into a drain or condensate neutralizing filter. Condensate from the Crest will be slightly acidic (typically with a pH from 3 to 5). Install a neutralizing filter if required by local codes.

   A neutralizer kit (FIG. 8-1) is available from the factory (KIT40045). The neutralizer kit must be placed on a surface that is a minimum of 3 inches lower than the condensate trap.
9. Do not expose condensate line to freezing temperatures.

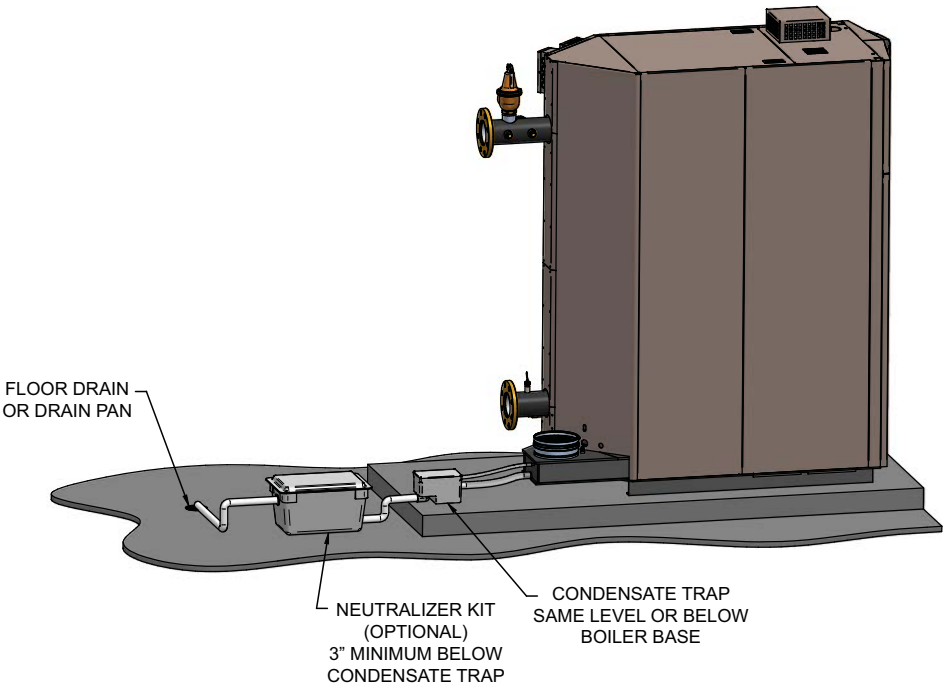
NOTICE Use materials approved by the authority having jurisdiction. In the absence of other authority, PVC and CPVC pipe must comply with ASTM D1785 or D2845. Cement and primer must comply with ASME D2564 or F493. For Canada use CSA or ULC certified PVC or CPVC pipe, fittings, and cement.

NOTICE To allow for proper drainage on large horizontal runs, a second line vent may be required and tubing size may need to increase to 1 inch (25 mm).

The condensate line must remain unobstructed, allowing free flow of condensate. If condensate is allowed to freeze in the line or if the line is obstructed in any other manner, condensate can exit from the boiler tee, resulting in potential water damage to property.

10. A condensate removal pump is required if boiler is below the drain. When installing a condensate pump, select one approved for use with condensing boilers and furnaces. The pump should have an overflow switch to prevent property damage from condensate spillage. The switch should be wired to the auxiliary device proving switch terminals on the low voltage connection board.

Figure 8-1 *Condensate Disposal*



9 Start-up

Check/control water chemistry

⚠ CAUTION Do not use petroleum-based cleaning or sealing compounds in the boiler system. Damage to elastomer seals and gaskets in the system could occur, resulting in substantial property damage.

Hardness less than 7 grains

1. Consult local water treatment companies for hard water areas (above 7 grains hardness).

Chlorine concentration less than 200 ppm

1. Do not fill boiler or operate with water containing chlorine in excess of 200 ppm.
2. Filling with chlorinated fresh water should be acceptable since drinking water chlorine levels are much lower.
3. Do not use the boiler to directly heat swimming pool or spa water.

Test/replace freeze protection fluid

1. For systems using freeze protection fluids, follow fluid manufacturer's instructions.
2. Freeze protection fluid must be replaced periodically due to degradation of inhibitors over time. Follow all fluid manufacturer's instructions.

Freeze protection (when used)

1. Determine freeze protection fluid quantity using system water content, following fluid manufacturer's instructions. Boiler water content is listed on page 6. Remember to include expansion tank water content.
2. Local codes may require a backflow preventer or actual disconnect from city water supply.
3. When using freeze protection fluid with automatic fill, install a water meter to monitor water makeup. Freeze protection fluid may leak before the water begins to leak, causing concentration to drop, reducing the freeze protection level.

Fill and test water system

1. Fill system only after ensuring the water meets the requirements of this manual.
2. Close manual and automatic air vents and boiler drain valve.
3. Fill to correct system pressure. Correct pressure will vary with each application.
   a. The minimum cold water fill pressure for a commercial system is 12 psi (82.7 kPa).
   b. Pressure will rise when boiler is turned on and system water temperature increases.
4. At initial fill and during boiler startup and testing, check system thoroughly for any leaks. Repair all leaks before proceeding further.

⚠ WARNING Eliminate all system leaks. Continual fresh makeup water will reduce boiler life. Minerals can build up in the heat exchanger, reducing heat transfer, overheating the heat exchanger, and causing heat exchanger failure.

Purge air from water system

1. Purge air from system:
2. Open automatic air vent (diaphragm-type or bladder-type expansion tank systems only) one turn.
3. Open other vents:
   a. Starting on the lowest floor, open air vents one at a time until water squirts out.
   b. Repeat with remaining vents.
4. Refill to correct pressure.

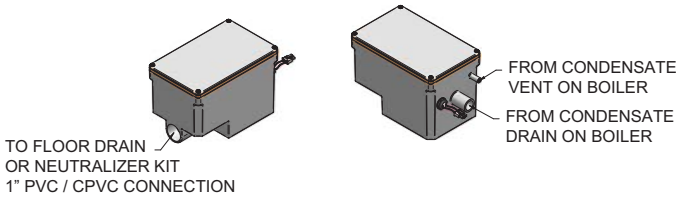
9 Start-up *(continued)*

Check for gas leaks

⚠ WARNING Before starting the boiler, and during initial operation, smell near the floor and around the boiler for gas odorant or any unusual odor. Remove the top access panel and smell the interior of the boiler enclosure. Do not proceed with startup if there is any indication of a gas leak. Use an approved leak detection solution. Repair any leaks at once.

⚠ WARNING DO NOT adjust or attempt to measure gas valve outlet pressure. The gas valve is factory set for the correct outlet pressure. This setting is suitable for natural gas and propane, requiring no field adjustment. Attempting to alter or measure the gas valve outlet pressure could result in damage to the valve, causing potential severe personal injury, death, or substantial property damage.

Figure 9-1 *Condensate Trap*



⚠ WARNING Propane boilers only – Your propane supplier mixes an odorant with the propane to make its presence detectable. In some instances, the odorant can fade, and the gas may no longer have an odor. Before startup (and periodically thereafter), have the propane supplier verify the correct odorant level in the gas.

Check thermostat circuit(s)

1. Disconnect the two external wires connected to the enable terminals on the connection board.
2. Connect a voltmeter across these two incoming wires. Close each thermostat, zone valve, and relay in the external circuit one at a time and check the voltmeter reading across the incoming wires.
3. There should NEVER be a voltage reading.
4. If a voltage does occur under any condition, check and correct the external wiring. (This is a common problem when using 3-wire zone valves.)
5. Once the external boiler enable wiring is checked and corrected if necessary, reconnect the external thermostat circuit wires to the connection board. Allow the boiler to cycle.

Inspect condensate system

Inspect/check condensate lines and fittings

1. Inspect the condensate drain line, condensate PVC fittings and condensate trap.

9 Start-up

Final checks before starting the boiler

- ❑ Read the Crest Service Manual to familiarize yourself with SMART TOUCH control module operation. Read this manual, page 43 for proper steps to start boiler.
- ❑ Verify the boiler and system are full of water and all system components are correctly set for operation.
- ❑ Verify the preparation procedures of Section 9, pages 40 and 41 have been completed.
- ❑ Verify electrical connections are correct and securely attached.
- ❑ Inspect vent piping and air piping for signs of deterioration from corrosion, physical damage or sagging. Verify air piping and vent piping are intact and correctly installed per this manual.

Start the boiler

1. Read and follow the Operating instructions in FIG. 9-2, page 43.

If boiler does not start correctly

1. Check for loose connections, blown fuse or service switch off?
2. Is external limit control (if used) open? Is boiler water temperature above 200°F (93°C)?
3. Is the boiler receiving a call for heat?
4. Is gas turned on at meter and boiler?
5. Is incoming gas pressure less than 4 inches w.c. (.99 kPa)?

If none of the above corrects the problem, refer to the Troubleshooting Section of the Crest Service Manual.

Check system and boiler

❑ Check water piping

1. Check system piping for leaks. If found, shut down the boiler and repair immediately. (See WARNINGS on pages 40 and 41 (startup) regarding failure to repair leaks.)
2. Vent any remaining air from the system using manual vents. Air in the system will interfere with circulation and cause heat distribution problems and noise.

❑ Check vent piping and air piping

1. Check for gastight seal at every connection, seam of air piping, and vent piping.

⚠ WARNING Venting system must be sealed gastight to prevent flue gas spillage and carbon monoxide emissions, which will result in severe personal injury or death.

❑ Check gas piping

1. Check around the boiler for gas odor following the procedure on page 31 of this manual (connecting gas supply piping).

⚠ WARNING If you discover evidence of any gas leak, shut down the boiler at once. Find the leak source with a bubble test and repair immediately. Do not start the boiler again until corrected. Failure to comply could result in severe personal injury, death, or substantial property damage.

Check flame and combustion

NOTICE For dual fuel models, reference the Crest Dual Fuel Supplemental Manual.

1. Turn the main power off to the boiler by placing the "On/Off" switch in the OFF position.
2. Remove the flue temperature sensor from the flue collector. **Note:** Combustion measurements will be made at this point.
3. Turn the main power on to the boiler by placing the "On/Off" switch in the ON position.

9 Start-up *(continued)*

Figure 9-2 *Operating Instructions*

FOR YOUR SAFETY READ BEFORE OPERATING

WARNING: If you do not follow these instructions exactly, a fire or explosion may result causing property damage, personal injury, or loss of life.

A. This appliance does not have a pilot. It is equipped with an ignition device which automatically lights the burner. Do not try to light the burner by hand.

B. BEFORE OPERATING smell all around the appliance area for gas. Be sure to smell next to the floor because some gas is heavier than air and will settle on the floor.

WHAT TO DO IF YOU SMELL GAS

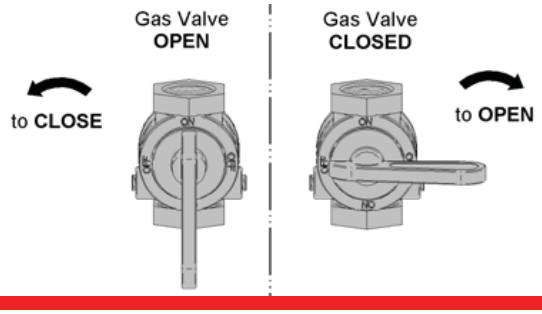
- Do not try to light any appliance.
- Do not touch any electric switch; do not use any phone in your building.
- Immediately call your gas supplier from a neighbor's phone. Follow the gas supplier's instructions.
- If you cannot reach your gas supplier, call the fire department.

C. Use only your hand to turn the gas control knob. Never use tools. If the handle will not turn by hand, don't try to repair it, call a qualified service technician. Force or attempted repair may result in a fire or explosion.

D. Do not use this appliance if any part has been under water. Immediately call a qualified service technician to inspect the appliance and to replace any part of the control system and any gas control which has been under water.

OPERATING INSTRUCTIONS

1. **STOP!** Read the safety information above on this label.
2. Set the thermostat to lowest setting.
3. Turn off all electric power to the appliance.
4. This appliance is equipped with an ignition device which automatically lights the burner. Do not try to light the burner by hand.
5. Remove front door.
6. Turn gas shutoff valve counterclockwise to "OFF". Handle will be perpendicular to pipe. Do not force.
7. Wait five (5) minutes to clear out any gas. If you then smell gas, **STOP!** Follow "B" in the safety information above this label. If you don't smell gas, go to next step.
8. Turn gas shutoff valve clockwise to "ON". Handle will be parallel to pipe.
9. Install front door.
10. Turn on all electric power to appliance.
11. Set thermostat to desired setting.
12. If the appliance will not operate, follow the instructions "To Turn Off Gas To Appliance" and call your service technician or gas supplier.



TO TURN OFF GAS TO APPLIANCE

1. Set the thermostat to lowest setting.
2. Turn off all electric power to the appliance if service is to be performed.
3. Remove front door.
4. Turn gas shut off valve counterclockwise to "OFF". Handle will be perpendicular to pipe. Do not force.
5. Install front door.

LBL20053 REV B

9 Start-up

Check flame and combustion *(continued)*

4. Navigate to the Service Screen from the Home Screen by pressing the MAIN MENU button and then the SERVICE button.
5. On the Service Screen place heater into Service Mode by selecting the START button, then selecting **Set Gas Valve 1 - High**.
6. Insert the probe from a combustion analyzer into the hole left by the removal of the flue temperature sensor.
7. Once the heat exchanger has modulated up to rate, measure the combustion. The values should be in the range listed in Table 9A below. CO levels should be less than 200 ppm for a properly installed unit. If the combustion is not within range reference the *Troubleshooting* Section in the Crest Service Manual for possible causes and corrective actions.

***Table 9A** Flue Products Chart*

Gas Valve	Natural Gas		Propane	
	CO_2	O_2	CO_2	O_2
1 - High	3.5% - 5.5%	11.2% - 14.8%	5.1% - 6.8%	10.5% - 13.2%
2 - High	7.8% - 8.6%	5.6% - 7.1%	9.4% - 11.0%	4.1% - 6.6%

8. After **Gas Valve 1** is set, repeat the same procedure for the second gas train by selecting **Set Gas Valve 2 - High** on the Service Screen.
9. Once the heater analysis is complete, test the safety shutoff device by turning the manual shutoff valve to the OFF position and ensuring that the heater shuts down and registers an alarm. Open the manual shutoff valve and reset the control.
10. Turn the main power off to the boiler and replace the flue temperature sensor into the flue pipe connection.
11. Place the boiler back into normal operation.

⚠ WARNING You must replace the flue gas temperature sensor to prevent flue gas spillage into the room. Failure to comply could result in severe personal injury, death, or substantial property damage.

Set space heating operation

Verify space heat circulator mode

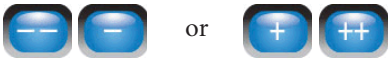
The system pump output can be programmed to never run (OFF), run only when a space heating demand is present (ON), or run continuously except during warm weather shutdown (WWSD). If the boiler is not heating an indirect HW (Hot Water) tank, it also turns on the boiler pump. After the space heating call for heat ends, and the system pump is programmed as ON, the system pump continues to run for a short period of time. If the boiler pump was running, it continues to run for a short period of time as well. These pump delays are factory set to 30 seconds. If different delays are desired, the appropriate parameters in the control must be changed. See the Crest Service Manual for a detailed explanation of this procedure.

Set space heating set point temperature

During normal operation, space heating set point temperatures can be adjusted from the Set Points Menu. Press the following buttons to navigate to the Set Points Menu from the Home Screen:

After pressing SETUP, the Password Screen will appear. Entering the correct password will allow access to all *Installer Level* adjustable parameters. Press ENTER without a password to access the *User Level* parameters.

1. To change a set point, use the arrows to highlight a user set point parameter and press the SELECT button.
2. The description of the selected parameter and its current setting will appear at the bottom of the screen.
3. To adjust the set point, press the following buttons to change the value being displayed:



4. Once the set point has been adjusted to the desired setting press the SAVE button to change the set point.
5. Once all the necessary adjustments have been made, press the HOME button to return to the Home Screen.

Note: The SAVE button must be pressed to ensure proper programming of the controls. Failure to press the SAVE button will require all changes to be reprogrammed.

9 Start-up *(continued)*

Set Hot Water Generator (HWG) operation

Verify HWG circulator mode

The HWG Mode is programmed to heat an indirect hot water tank. When a tank thermostat or a tank sensor initiates a call for heat, the SMART TOUCH control will turn on the HW pump and turn off the boiler pump (if running). If the system pump is running, it will remain on. When the HW call for heat ends, and there is no space heating call for heat, the HW pump will continue to run for a period of time. This pump delay is set at the factory to 60 seconds. If a shorter or longer delay is desired, the appropriate parameter in the control must be changed. See the Crest Service Manual for a detailed explanation of this procedure. If there is an active space heating call for heat, then the boiler pump will be turned on and the HW pump will be turned off.

Set HWG target temperature

When in the HWG Mode, the control will modulate to maintain the outlet temperature to a set point. This set point is set at the factory to 180°F. If a different set point is desired, the appropriate parameter in the control must be changed. See the Crest Service manual for a detailed explanation of this procedure.

If a tank sensor is installed, the HWG heat demand will start when the tank temperature drops 6°F below the tank set point, and stop when the tank temperature reaches the tank set point. The tank set point is set at the factory to 120°F (49°C).

Set clock

Press the following buttons to program the clock:

After pressing SETUP, the Password Screen will appear. Entering the correct password will allow access to all *Installer Level* adjustable parameters. Press ENTER without a password to access the *User Level* parameters.

The SMART TOUCH control has a built-in clock that it uses for its night setback feature and for logging events. This clock must be set when the boiler is installed, and anytime the boiler has been powered off for more than one day. Use the following procedure to set the clock:

1. To set the clock, highlight Clock using the arrows and press the SELECT button. Use the left and right arrows to select hours, minutes, AM/PM and the up and down arrows to set.
2. To set the date, highlight Date using the arrows and press the SELECT button. Use the left and right arrows to select the day of the week and the up and down arrows to set.

NOTICE The internal clock does not adjust for Daylight Savings Time and therefore, will require a manual adjustment.

Configuration of the cascade

When installed in a Cascade system, the individual controls must be programmed for cascade operation. To program the cascade parameters, access the Cascade Menu found in the Setup Menu by pressing the following buttons:

After pressing SETUP, the correct installer password MUST BE entered.

1. Once in the Cascade Setup Menu select the appropriate parameter using the arrows and press the SELECT button.
2. The description of the selected parameter and its current setting will appear at the bottom of the screen.
3. To adjust the parameter, press the + or - buttons to change the value being displayed.
4. Make the correct adjustments and then press the SAVE button.
5. Once all the parameters have been adjusted press the BACK button. This will return you to the Cascade Screen.

Note: The SAVE button must be pressed to ensure proper programming of the controls. Failure to press the SAVE button will require all changes to be reprogrammed.

10 Operating information

General

How the boiler operates

The Crest uses an advanced stainless steel heat exchanger and electronic control module that allows fully condensing operation. The blowers pull in air and push flue products out of the boiler through the heat exchanger and flue piping. The control module regulates blower speeds to control the boiler firing rate. The gas valves sense the amount of air flowing into the boiler and allow only the right amount of gas to flow.

How the control modules operate

The Crest boiler is equipped with a SMART TOUCH control module. The SMART TOUCH control module receives inputs from boiler sensors and external devices. The control module activates and controls the blowers and gas valves to regulate heat input and switches the boiler, Hot Water Generator (HWG), and system pumps on and off as needed. The user programs the control module to meet system needs by adjusting control parameters. These parameters set operating temperatures and boiler operating modes.

Control inputs and outputs

Enable

This input tells the boiler to provide water for space heating.

Hot Water Generator (HWG) tank thermostat

This input tells the boiler to provide water for heating an indirect HW tank.

0 - 10V BMS input (set point or power)

The Crest can be controlled by a Building Management System (BMS) using a 0 - 10 VDC signal. The control can be configured by the installer to use this signal to either control set point or firing rate.

0 - 10V System Pump speed input

When a variable speed system pump is used, and there is a 0 - 10V signal available from the pump speed control, this signal may be connected to the boiler. Doing so will allow the boiler to anticipate changes in the BTU's needed by the system as the system flow changes, and therefore, help the boiler to maintain the desired system temperature. Connect the - input terminal to the COM or - output terminal on the pump speed control, and the + input terminal to the 0 - 10V or + output terminal on the pump speed control. Note that the voltage on these inputs must never go below ground.

HWG priority

The SMART TOUCH control module allows connection of a HW thermostat or sensor to the low voltage connection board. When the HW thermostat or sensor calls for heat, the control module activates the HW pump, shuts down the boiler pump, and immediately sets the target outlet water temperature to 180°F (82.2°C).

This provides automatic priority heat allocation to the HW Generator for maximum response and recovery. The HW pump continues for 60 seconds after the heating cycle to deliver the most possible heat. The control module can be programmed to limit the firing rate of the boiler during a HW call for heat.

Controlling sensor

The control module is programmed to use the outlet sensor as the control sensor by default. If a system supply sensor is connected, the control automatically uses it as the control sensor. The control module may be programmed to use the inlet sensor as the control sensor instead. In this case, the control will use the system return sensor if it is connected.

Anti-cycling

After a space heating demand has been satisfied, the control will delay the next space heating call for a set time period (time is adjustable by the installer). The time delay will be bypassed if the inlet water temperature drops too far during the delay.

Boiler, system, and HW pump control

When a space heating call for heat starts and no HWG call is on, the boiler pump is turned on. The system pump will turn on also if it is programmed to do so. If a HWG call for heat is on, the boiler pump will wait to turn on until just before the HWG pump turns off. After the space heating call for heat ends, the boiler pump will run for an additional period of time.

When a HWG call for heat starts, the HWG pump is turned on. If a space heating call for heat is on, the boiler pump will turn off a few seconds after the HWG pump turns on.

Louver

When the boiler needs to control combustion air louvers, connect a 24 VAC louver relay to the two (2) Louver Relay terminals. Connect the Louver End Switch to the Louver Proving Switch input on the Low Voltage Connection Board.

Temperature control

Modulation

The Crest is capable of modulating its firing rate from a minimum of 4 - 6% (model specific) to a maximum of 100%. The firing rate is dictated by the call for heat (i.e., space heating or hot water generation), the heating load, ramp delay (if enabled), and various other temperature limitations.

10 Operating information *(continued)*

Gradient limiting

If during operation of the boiler the outlet water temperature is rising too quickly, the control will reduce the firing rate to its lowest setting.

Outdoor air reset

If an outdoor air sensor is connected, the control module will calculate the set point based on the programmed reset curve. The installer can change the slope of the reset curve by several adjustable parameters. The user can limit the maximum set point for the system using the space heating set point.

Boost function

If outdoor air reset is active, the boost temperature is not 0, a space heating demand has been active continuously for a set period of time (time adjustable by installer) and there has been no HWG demands, the control will increase the set point by a fixed number of degrees (adjustable by installer). This process will continue until the space heating demand ends, the set point reaches the programmed set point or a maximum of 20 increases has occurred. Once the system heat demand is satisfied, the set point will revert to the value determined by the reset curve.

Night setback

The controller may be programmed to reduce the space heating set point and/or Hot Water Generator set point for each demand during a certain time each day. A start and stop time for each demand can be programmed for each day of the week. The controller can be programmed to reduce the tank set point as well. A different set of start and stop times can be programmed each day of the week.

Flame current support

To prevent nuisance shutdowns when the boiler is firing at minimum rates, the control will increase the firing rate when the flame signal drops too low.

ModBus

The Crest boiler can be connected to and controlled by a Building Automation System through the ModBus interface. Connect the A and B wires to the A and B terminals. If connecting another cable (in a daisy chain), connect the shield wire of the first cable to one of the shield terminals, and the shield wire of the second cable to the other shield terminal. If it is desired to ground the cable shield at the heater, connect the shield wire to one of the shield terminals, and install a jumper across the two (2) terminals in connector X5 on the ModBus interface board.

0-10V Rate output

A 0-10V signal which indicates the firing rate of the heater is available. This output may be connected to a Building Management System (BMS) to allow it to monitor the actual firing rate. Connect the - terminal to the COM or - terminal on the BMS, and connect the + terminal to the 0 - 10V or + terminal on the BMS.

Ramp Delay

For systems with lower flow, the SMART TOUCH can limit the firing rate (when enabled) when a space heating call for heat starts, or when switching from a DHW call for heat to a space heating call for heat. There are six (6) limits that can be programmed, as well as six (6) time intervals corresponding to each limit. The sixth limit will also limit the firing rate for the rest of the call for heat.

Protection features

Outlet temperature, flue temperature, and temperature rise limiting

The outlet water temperature is monitored by the boiler outlet temperature sensor. When the outlet temperature exceeds 185°F, the unit will reduce the fan speed. If the outlet water temperature exceeds 195°F (90°C) the control will shut the unit down until the minimum off time has expired and the outlet drops 10°F (5.5°C).

The control module monitors the flue temperature by a sensor located in the flue exhaust. If the flue temperature exceeds 350°F (176°C) the control will reduce the maximum fan speed. If the flue temperature exceeds 400°F (204°C) the control will shut the unit down. The unit will restart automatically once the flue temperature drops 50°F (27°C) and the minimum off time has expired.

The control monitors the temperature difference between the inlet and the outlet sensor. If this difference exceeds 80°F (27°C) the control will reduce the fan speed. If the temperature difference exceeds 90°F (32°C) the control will shut the unit down. The unit will restart automatically once the temperature difference has dropped below 50°F (28°C) and the minimum off time has expired.

Freeze protection

DO NOT install the boiler in a room likely to freeze.

The following integral feature of the SMART TOUCH control module provides some protection for the boiler only -- not for the system.

- The SMART TOUCH control module provides freeze-up protection as follows when the boiler water temperature drops below 45°F (7°C):
- Below 45°F (7°C), the boiler and system pumps (if enabled) operate constantly.
- Below 37°F (3°C), the boiler turns on.
- Boiler and pumps turn off if boiler water temperature rises above 43°F (6°C).

⚠ CAUTION This feature of the SMART TOUCH control module does not eliminate the possibility of freezing. The installation must still use recognized design, installation and maintenance practice to prevent freeze potential for the boiler and system.

10 Operating information

Monitor external limits

Connections are provided on the connection board for external limits such as an additional high limit. The SMART TOUCH control will shut off the burner and inhibit relighting whenever any of these external limits open.

Run-time and alarm outputs

The boiler provides dry contacts for indicating when the boiler is running, and when it is unable to operate.

Run-time and cycle counting

The control uses four timers to monitor the total hours of burner operation:

75 - 100%	50 - 75%
25 - 50%	<25%

The control uses four (4) ignition counters to monitor the amount of boiler cycles. The first counter counts all ignitions of the control. The second counter counts only ignition attempts that have failed. The third and fourth counters are the same as the first and second respectively, but can be reset by the installer.

Service reminder

The control can be programmed for service reminder notification. This notification will become active when either a set amount of time has expired, or a set amount of running hours or cycles has expired (all adjustable by the installer). The service reminder notification can be reset by the installer. The service company's name and phone number can be programmed to display when service is due.

Error logging

The control will hold in memory the last 10 blocking faults as well as the last 10 lockout faults. The date and time of the occurrence will be recorded as well. Only the 10 most recent occurrences will be held in memory.

Boiler temperature regulation

Operating temperature (target)

The SMART TOUCH control module senses water temperature and regulates boiler firing and firing rate to achieve a target temperature. The target temperature can be set between 32°F (0°C) and 185°F (85°C).

- Target temperature is fixed when the outdoor sensor is not installed.
- Target temperature is calculated as described under "Outdoor Reset Operation" and "Target Temperature Boost" when the outdoor sensor is connected.

High limit operations

The Crest SMART TOUCH control has two (2) integral limits, one auto reset and one manual reset. The Crest also has one auxiliary manual reset high limit. The integral and auxiliary high limits are UL353 certified.

When the outlet temperature exceeds 195°F (90.6°C) (Installer Adjustable Parameter), integral auto reset high limit action occurs. The boiler will shut down until the outlet water cools down and the timer expires.

If the outlet temperature exceeds 200°F (93.3°C) (User Adjustable Dial), auxiliary manual reset high limit action occurs. The boiler will shut down until the outlet water cools down and the boiler is reset through the user interface.

If the outlet temperature exceeds 205°F (93.3°C) (Installer Adjustable Parameter), integral manual reset high limit action occurs. The boiler will shut down until the outlet water cools down and the boiler is reset through the user interface.

Low water cutoff protection

A low water cutoff device with test and reset functionality is provided in the boiler as standard equipment.

Flow sensing device

The SMART TOUCH control module uses temperature sensing of both supply and return temperatures of the heat exchanger. If the flow rate is too low or the outlet temperatures too high, the control module modulates down and will shut the boiler off. This ensures boiler shutdown in the event of low flow conditions.

NOTICE If a mechanical flow switch is required to meet local code requirements the Crest boiler can be equipped with a field supplied outlet switch. Please reference page 38 of this manual for more information.

Outdoor reset operation, if used

Target temperature with outdoor reset

This feature improves the system's efficiency as the outdoor temperature warms up.

See the Crest Service Manual to change the settings.

Reset curve

The reset curve looks at outdoor air temperature and adjusts the set point.

10 Operating information *(continued)*

Cascade

When multiple boilers are installed, they can be wired together in a cascade sequence. A maximum of eight boilers can be controlled from a single control. In this application one boiler would be designated as the Leader control and all others would be designated as Member controls.

Once the Leader boiler receives a call for heat from the Enable input, the 0 - 10 VDC input, or ModBus, the control will determine what the set point will be. If outdoor air reset is desired, connect the outdoor air sensor to the terminals on the Low Voltage Connection Board on the Leader boiler. The set point will be calculated based on the programmed reset curve parameters. See the Crest Service Manual to program the reset curve. If outdoor air reset is not desired, do not connect the outdoor air sensor. A fixed temperature set point can be programmed into the control, or provided through the ModBus interface.

If the water temperature at the controlling sensor is less than the set point + the turn-off offset - the off-on differential, the control will initiate a call for heat on the Cascade (see the Crest Service Manual for an explanation of the offset and differential). The Leader will energize the lead boiler on the Cascade. For a new startup this will be the Leader boiler.

The boiler will fire at its ignition speed and will then modulate its firing rate to maintain the set point. If the first boiler reaches 80% of its firing rate, the Leader will calculate the rate at which the first and second boiler should fire to meet the load. At this point, the Leader will fire the second boiler on the Cascade. For a new startup, this would be the first Member boiler. The boiler will fire at its ignition speed, and then both the Leader and the Member boilers will modulate together to a firing rate to maintain set point.

If the set point cannot be met, the Leader will continue firing additional Members until either the heat demand is met or all boilers on the Cascade are firing. As additional Member boilers are fired, the running boilers in the Cascade will modulate together to meet load.

As the heat demand decreases, the boilers firing in the Cascade will modulate down together until they reach a minimum of 10% of its firing rate, where the last boiler will shut down and the remaining boilers will modulate together to meet load. As the heat demand decreases further, the second to last boiler will shut down. This will continue until the demand is satisfied and all boilers are shut off.

Sequence of the cascade

To equalize the run time of all boilers on the Cascade, the firing sequence will automatically be changed at set intervals.

For the first 24 hours after initializing the Cascade, the sequence will be changed every hour. After that the sequence will be changed once every 24 hours.

HW operation with cascade

For HW operation any boiler(s) in the Cascade can be selected to provide heat for a HW call. Select a boiler to be designated as the HW boiler. Connect the HW thermostat or sensor to the terminals on the Low Voltage Connection Board marked for the HW Thermostat or sensor. When the boiler receives a HW call, the Leader control will take that boiler out of the Cascade sequence. If another boiler is available, the Leader will start it up to take its place.

The HW boiler will adjust its set point to the programmed HW set point and will adjust its firing rate to maintain this. Once the HW call has been satisfied, the Leader control will place that boiler back into the Cascade sequence.

Night Setback and Ramp Delay operations with cascade

Night Setback and Ramp Delay operation of the boilers within the Cascade are available. Programming will be done through the Leader boiler. Refer to the Crest Service Manual for information regarding Night Setback and Ramp Delay.

10 Operating information

Sequence of operation

Note: This unit is equipped with two (2) gas train systems. Gas Train 1 will fire first. If the demand cannot be met by the first gas train, the second gas train (Gas Train 2) will fire.

1.	Upon a call for heat, the control turns on the appropriate pumps (system and boiler pumps for a space heating call, HW pump for a domestic hot water call).
2.	The control confirms that the low water cutoff contacts are closed and energizes the louvers (optional) and damper (optional) relays.
3.	The control confirms that the gas pressure switch, blocked drain switch, limits, louver proving switch (optional) and damper proving switch (optional) contacts close. The Pre-Purge cycle begins.
4.	The control confirms both blowers come up to the desired speed, both blower proving switches close, and the air pressure switch is closed.
5.	Once the Pre-Purge cycle is complete, the control lowers the blower speeds, initiates sparking of the ignition electrode, and opens Gas Valve 1.
6.	After a short wait, the control stops sparking and checks for the presence of flame current through the flame sense electrode.
7.	If the control does not detect flame current, the control will lockout indefinitely, until the RESET button on the touch screen LCD is pressed. Models FB 1500 - 2500 will have one retry.
8.	If the control detects flame current, the control will hold the blower speed constant for a few seconds to allow the flame to stabilize, then begin modulating the firing rate in order to maintain the controlling sensor to the desired set point temperature.
9.	If the current call for heat is for space heating and a HW call for heat becomes active, the control will turn on the HW pump relay output, then turn off the boiler pump. It will then modulate the blower speed in order to maintain the outlet temperature to the desired HW outlet set point temperature.
10.	If the first combustion system in the boiler is unable to maintain the desired set point temperature, the second combustion system in the boiler will be started. Both blowers will modulate to a set speed, and the second gas valve will be energized. The second combustion system will light from the first combustion system. The second flame will be monitored much like the first. Once both combustion systems are firing, the control will work in synchronization to maintain the desired set point temperature. If the heat load should decrease sufficiently, the second combustion system will be shut down.
11.	Once both the space heating and HW calls for heat are satisfied, the control will turn off the gas valve(s) and begin the Post-Purge cycle. Any pumps that are running will begin their respective Pump Delay cycles.
12.	At the end of the Post-Purge cycle, the louver relay contacts will de-energize.
13.	The control verifies that the blowers stop running and the blower proving switches open.
14.	At the end of the Pump Delay cycle(s), the pump(s) will be turned off.

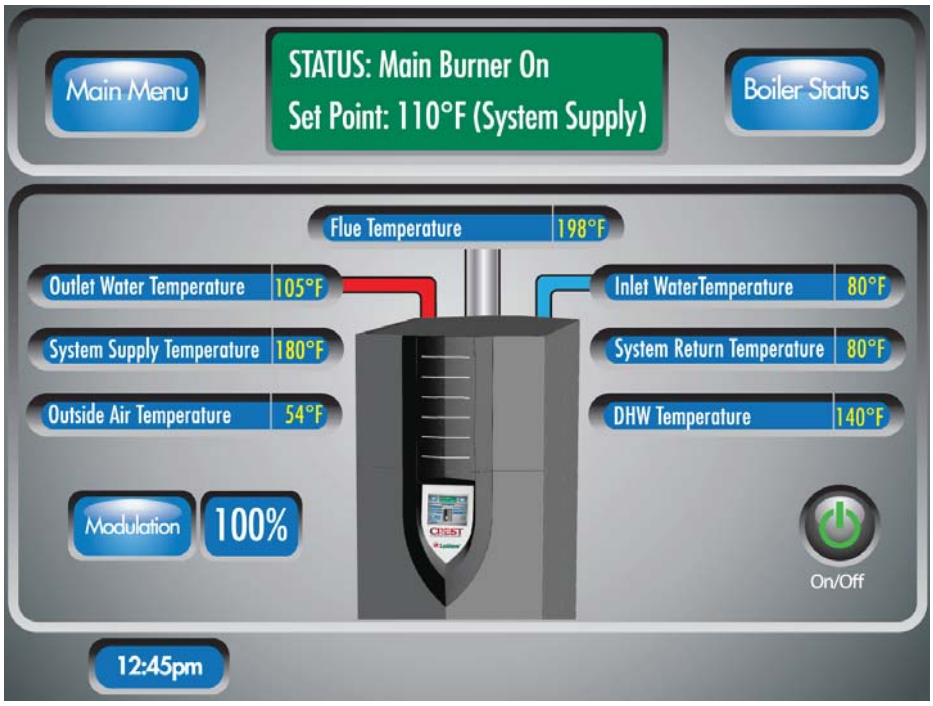
10 Operating information *(continued)*

SMART TOUCH™ Crest control module

The Home Screen displays status, modulation rate, outlet water temperature, inlet water temperature, flue temperature, system supply temperature, system return temperature, outdoor air temperature, and domestic hot water tank temperature.

The boiler can be started and stopped by pressing the ON/OFF button. The Boiler Status Screen and Main Menu Screen can be accessed by pressing the appropriate button.

Figure 10-1 *Home Screen*



When the ON/OFF switch is turned to the ON position, the first screen visible on the LCD display will be the Home Screen. This screen displays the current status of the Crest boiler. The following items can be viewed or interacted with on the Home Screen:

On/Off button - Pressing this button allows the boiler to be placed in either Manual Shutdown Mode or Standby Mode.

Status - This line shows the current operating status of the Crest boiler and the current set point.

Outlet Water Temperature - This is the boiler outlet temperature.

Inlet Water Temperature - This is the boiler inlet temperature.

System Supply Temperature - This is the water temperature as measured by the system supply sensor located in the downstream piping (if connected).

System Return Temperature - This is the water temperature measured by the system return sensor located in the upstream piping (if connected).

Outside Air Temperature - This is the outdoor air temperature (if connected).

DHW Temperature - This is the temperature as measured by the tank sensor in the hot water storage tank (if connected).

Flue Temperature - Temperature measured by the flue sensor.

Time - The time is displayed in the lower left-hand corner of the display. Reference the Crest Service Manual for Night Setback parameters and more information regarding adjusting the date and time.

Boiler Status button - Pressing this button brings up the Boiler Status Screen. This screen shows the status of the various safeties, inputs, and outputs to the control module. Reference the Boiler Status Screen section in the Crest Service Manual for more information regarding this screen.

Main Menu button - Pressing this button brings up the Main Menu Screen. From this screen navigation to nine (9) other screens is possible. Reference the Main Menu Screen section on page 52 of this manual for more information regarding this screen.

Modulation button - Pressing this button brings up the Modulation Screen. This screen shows overall boiler modulation, individual fan speeds, and flame currents.

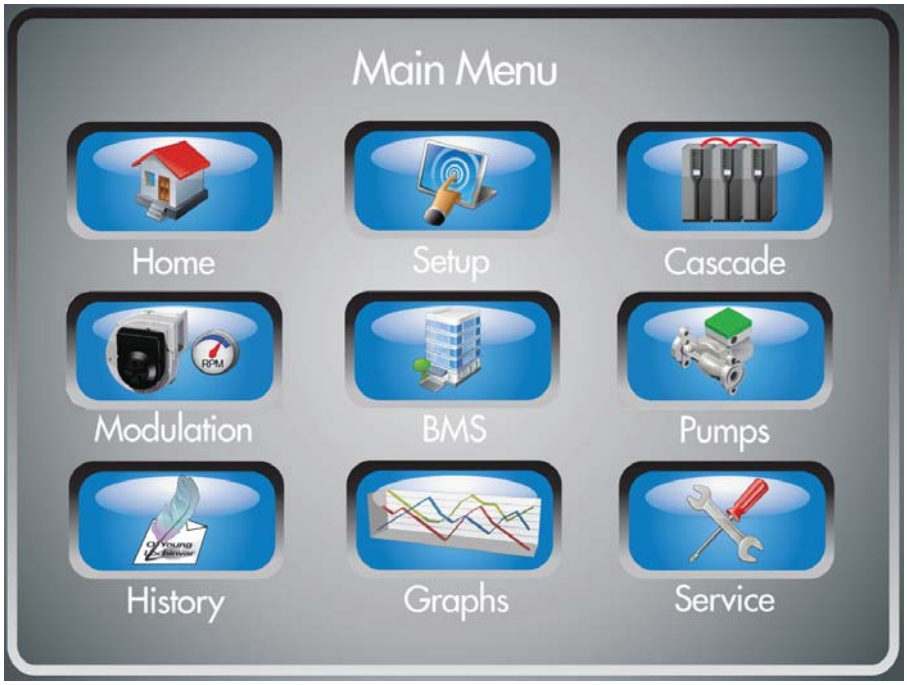
Modulation Percentage - Displays the current boiler firing rate.

10 Operating information

Use the Main Menu Screen (FIG. 10-2) to access the screens necessary to set temperatures, operating conditions, and monitor boiler operation.

The Crest is equipped with a SMART TOUCH control system. All menu options are accessed by touching the screen with your finger or a stylus from a PDA.

Figure 10-2 *Main Menu Screen*



The Main Menu Screen allows navigation to nine (9) additional screens which are used to set temperatures, operating conditions, and monitor boiler operation. These screens are as follows:

- Home - Navigates back to the Home Screen.
- Setup - Allows access to 12 other screens for the adjustment of the control parameters.
- Cascade - Shows the status of multiple boilers connected together in a cascade arrangement (Leader only).
- Modulation - Shows the status of the two (2) gas train systems used in the boiler.
- BMS - Shows the information from a Building Integration System.
- Pumps - Allows the installer to configure the boiler, system, and DHW pumps.
- History - Shows the operating and fault history of the control module.
- Graphs - Allows the selection of items to be graphed on a chart.
- Service - Allows the installer to control the fan speed of the individual combustion systems for the purposes of combustion analysis. Service Mode will override all other heat demands, however, all limits will remain active.

Reference the Crest Service Manual for more information regarding the nine (9) accessible screens.

11 Maintenance

Maintenance and annual startup

Table 11A *Service and Maintenance Schedules*

Service technician
(see the following pages for instructions)

ANNUAL START-UP

General:

- Address reported problems, if any
- Inspect interior; clean and vacuum if necessary;
- Clean condensate trap and fill with fresh water
- Check for leaks (water, gas, flue, condensate)
- Verify flue and air lines in good condition and sealed tight
- Check system water pressure/system piping/expansion tank
- Check control settings
- Check the ignition and both flame sense electrodes (sand off any deposits; clean and reposition)
- Check wiring and connections
- Perform start-up checkout and performance verification per Section 9.
- Flame inspection (stable, uniform)
- Check both flame signals (at least 10 microamps at high fire)
- Clean the heat exchanger
- Test low water cutoff (reference the Crest Service Manual).

If combustion or performance indicate need:

- Clean heat exchanger
- Remove and clean burner using compressed air only
- Clean the blower wheels

Owner maintenance
(see the Crest User's Information Manual for instructions)

Daily	• Check boiler area • Check pressure/temperature gauge
Monthly	• Check vent piping • Check air piping • Check air and vent termination screens • Check relief valve • Check condensate drain system
Every 6 months	• Test low water cutoff • Reset button (low water cutoff) • Check boiler piping (gas and water) for leaks • Operate relief valve
End of season months	• Shut boiler down (unless boiler used for domestic hot water)

11 Maintenance

⚠ WARNING Follow the service and maintenance procedures given throughout this manual and in component literature shipped with the boiler. Failure to perform the service and maintenance could result in damage to the boiler or system. Failure to follow the directions in this manual and component literature could result in severe personal injury, death, or substantial property damage.

⚠ WARNING The boiler should be inspected annually only by a qualified service technician. In addition, the maintenance and care of the boiler designated in Table 11A and explained on the following pages must be performed to assure maximum boiler efficiency and reliability. Failure to service and maintain the boiler and system could result in equipment failure.

⚠ WARNING Electrical shock hazard – Turn off power to the boiler before any service operation on the boiler except as noted otherwise in this instruction manual. Failure to turn off electrical power could result in electrical shock, causing severe personal injury or death.

Address reported problems

1. Inspect any problems reported by the owner and correct before proceeding.

Inspect boiler area

1. Verify that boiler area is free of any combustible materials, gasoline and other flammable vapors and liquids.
2. Verify that air intake area is free of any of the contaminants listed in Section 1 of this manual. If any of these are present in the boiler intake air vicinity, they must be removed. If they cannot be removed, reinstall the air and vent lines per this manual.

Inspect boiler interior

1. Remove the front access covers and inspect the interior of the boiler.
2. Vacuum any sediment from inside the boiler and components. Remove any obstructions.

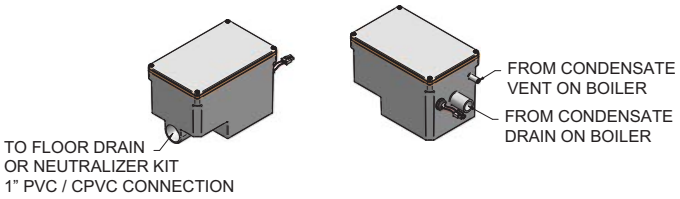
Clean condensate trap

1. Inspect the condensate drain line, vent line, condensate PVC fittings, and condensate trap.

Flush condensate trap with water

1. Remove the four (4) screws securing the top cover to the condensate trap and remove the cover (FIG. 11-1).
2. Locate the plastic ball inside the float tube. Verify there is nothing under the ball causing it to not seat properly.
3. Fill with fresh water until the water begins to pour out of the drain.
4. Replace the top cover and the screws removed in Step 1.

Figure 11-1 *Condensate Trap*



Check all piping for leaks

⚠ WARNING Eliminate all system or boiler leaks. Continual fresh makeup water will reduce boiler life. Minerals can build up, reducing heat transfer, overheating heat exchanger, and causing heat exchanger failure. Leaking water may also cause severe property damage.

1. Inspect all water and gas piping and verify to be leak free.
2. Look for signs of leaking lines and correct any problems found.
3. Check gas line using the procedure found in Section 6 - *Gas Connections*.

11 Maintenance *(continued)*

Flue vent system and air piping

1. Visually inspect the entire flue gas venting system and air piping for blockage, deterioration or leakage. Repair any joints that show signs of leakage. Verify that air inlet pipe is connected and properly sealed.

2. Verify that boiler vent discharge and air intake are clean and free of obstructions.

⚠ WARNING Failure to inspect for the above conditions and have them repaired can result in severe personal injury or death.

Check water system

1. Verify all system components are correctly installed and operational.

2. Check the cold fill pressure for the system. Verify it is correct (must be a minimum of 12 psi (82.7 kPa)).

3. Watch the system pressure as the boiler heats up (during testing) to ensure pressure does not rise too high. Excessive pressure rise indicates expansion tank sizing or performance problem.

4. Inspect automatic air vents and air separators. Remove air vent caps and briefly press push valve to flush vent. Replace caps. Make sure vents do not leak. Replace any leaking vents.

Check expansion tank

1. Expansion tanks provide space for water to move in and out as the heating system water expands due to temperature increase or contracts as the water cools. Tanks may be open, closed or diaphragm or bladder type. See Section 5 - *Hydronic Piping* for suggested best location of expansion tanks and air eliminators.

Check boiler relief valve

1. Inspect the relief valve and lift the lever to verify flow. Before operating any relief valve, ensure that it is piped with its discharge in a safe area to avoid severe scald potential. Read Section 5 - *Hydronic Piping* before proceeding further.

⚠ WARNING Safety relief valves should be re-inspected AT LEAST ONCE EVERY THREE YEARS, by a licensed plumbing contractor or authorized inspection agency, to ensure that the product has not been affected by corrosive water conditions and to ensure that the valve and discharge line have not been altered or tampered with illegally. Certain naturally occurring conditions may corrode the valve or its components over time, rendering the valve inoperative. Such conditions are not detectable unless the valve and its components are physically removed and inspected. This inspection must only be conducted by a plumbing contractor or authorized inspection agency – not by the owner. Failure to re-inspect the boiler relief valve as directed could result in unsafe pressure buildup, which can result in severe personal injury, death, or substantial property damage.

⚠ WARNING Following installation, the valve lever must be operated AT LEAST ONCE A YEAR to ensure that waterways are clear. Certain naturally occurring mineral deposits may adhere to the valve, rendering it inoperative. When manually operating the lever, water will discharge and precautions must be taken to avoid contact with hot water and to avoid water damage. Before operating lever, check to see that a discharge line is connected to this valve directing the flow of hot water from the valve to a proper place of disposal. Otherwise severe personal injury may result. If no water flows, valve is inoperative. Shut down the boiler until a new relief valve has been installed.

2. After following the above warning directions, if the relief valve weeps or will not seat properly, replace the relief valve. Ensure that the reason for relief valve weeping is the valve and not over-pressurization of the system due to expansion tank waterlogging or undersizing.

11 Maintenance

Inspect ignition and flame sense electrodes

1. Remove the ignition and both flame sense electrodes from the burner plate.
2. Remove any deposits accumulated on the ignition/ flame sense electrodes using sandpaper. If the electrodes cannot be cleaned satisfactorily, replace with new ones.
3. Replace ignition/flame sense electrodes, making sure the gaskets are in good condition and correctly positioned.

Check ignition ground wiring

1. Inspect boiler ground wire from the heat exchanger access cover to ground terminal strip.
2. Verify all wiring is in good condition and securely attached.
3. Check ground continuity of wiring using continuity meter.
4. Replace ground wires if ground continuity is not satisfactory.

Check all boiler wiring

1. Inspect all boiler wiring, making sure wires are in good condition and securely attached.

Check control settings

1. Navigate to the Setup Screen and check all settings. See Section 1 of the Crest Service Manual. Adjust settings if necessary. See Section 1 of the Crest Service Manual for adjustment procedures.
2. Check settings of external limit controls (if any) and adjust if necessary.

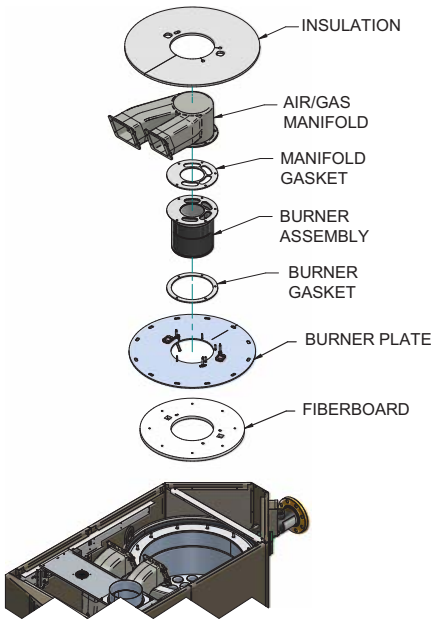
Perform start-up and checks

1. Start boiler and perform checks and tests specified in Section 9 - *Start-up*.
2. Verify cold fill pressure is correct and that operating pressure does not go too high.

Check burner flame

1. Inspect flame through observation windows.
2. If the flame is unsatisfactory at either high fire or low fire, remove and clean the burner. Clean the burner thoroughly using a vacuum cleaner or compressed air. Do not use compressed air to clean the burner if cleaning is performed inside a building.
   - Shut down the boiler:
     - Follow the "To Turn Off Gas to Appliance" instructions for the boiler in Section 9 - Startup.
     - Do not drain the boiler unless it will be exposed to freezing temperatures. If using freeze prevention fluid in system, do not drain.
3. Allow time for the boiler to cool to room temperature if it has been firing.
4. Remove the top access panel to remove the gas/air manifold assembly.
5. Remove the nuts securing the burner to the burner mounting plate. Remove the burner (FIG. 11-2).
6. When replacing the burner, ensure gaskets are in good condition and positioned correctly (FIG. 11-2).
7. When securing the burner, be sure to tighten the nuts, but DO NOT over-tighten. Tighten the nuts to a torque setting of no more than 6.2 ft.-lbs. When securing the burner mounting plate be sure to tighten the nuts, but DO NOT over-tighten. Tighten the nuts to a torque setting of no more than 15.5 ft.-lbs.

Figure 11-2 *Burner Assembly*



Check flame signal

1. At high fire of each combustion system, the flame signal shown on the display should be at least 10 microamps.
2. A lower flame signal may indicate a fouled or damaged flame sense electrode. If cleaning the flame sense electrodes does not improve, ground wiring is in good condition, and ground continuity is satisfactory, replace the flame sense electrode.
3. See Section 3 - *Troubleshooting* in the Crest Service Manual for other procedures to deal with low flame signal.

11 Maintenance *(continued)*

Review with owner

1. Review the Crest User's Information Manual with the owner.
2. Emphasize the need to perform the maintenance schedule specified in the Crest User's Information Manual (and in this manual as well).
3. Remind the owner of the need to call a licensed contractor should the boiler or system exhibit any unusual behavior.
4. Remind the owner to follow the proper shutdown procedure and to schedule an annual start-up at the beginning of the next heating season.

Cleaning boiler heat exchanger

1. Shut down boiler:
   - Follow the "To Turn Off Gas to Appliance" instructions for the boiler in Section 9 - Startup.
   - Do not drain the boiler unless it will be exposed to freezing temperatures. If using freeze prevention fluid in system, do not drain.
2. Allow time for the boiler to cool to room temperature if it has been firing.
3. Remove the top access panel to remove the gas/air manifold assembly.
4. Remove the nuts securing the burner to the burner mounting plate. Remove the burner (FIG. 11-2).
5. Remove the nuts securing the burner mounting plate from the heat exchanger and set aside. Remove the entire burner mounting plate assembly.

⚠ WARNING The boiler contains ceramic fiber materials. Use care when handling these materials per instructions on this page. Failure to comply could result in severe personal injury.

6. Use a vacuum cleaner to remove any accumulation on the tube sheet surfaces. Do not use any solvent.
7. Brush the heat exchanger (tube sheet, combustion chamber walls, and tube entry) while dry using a nylon bristle brush. **Caution:** DO NOT use a metal brush. Re-vacuum the heat exchanger.
8. Finish cleaning using a clean cloth dampened with warm water.
9. Temporarily remove the condensate drain line from the condensate trap and route directly to a drain.
10. Rinse out debris with a low pressure water supply. The water will drain through the condensate connection.
11. Allow the heat exchanger to thoroughly dry.
12. Reconnect the condensate drain line to the condensate trap.
13. Close isolation valves on piping to isolate boiler from system. Attach a hose to the boiler drain and flush boiler thoroughly with clean water by using purging valves to allow water to flow through the water make-up line to the boiler.
14. When securing the burner, be sure to tighten the nuts, but DO NOT over-tighten. Tighten the nuts to a torque setting of no more than 6.2 ft.-lbs. When securing the burner mounting plate be sure to tighten the nuts, but DO NOT over-tighten. Tighten the nuts to a torque setting of no more than 15.5 ft.-lbs.
15. Replace the burner mounting plate assembly and gas/air manifold assembly. Ensure gaskets are in good condition and positioned properly. Restore boiler to operation.
16. Perform start-up and check-out procedures in the Check Flame and Combustion - Section 9 - Startup on pages 42 and 44 of this manual.

Handling ceramic fiber materials

REMOVAL OF COMBUSTION CHAMBER LINING

⚠ WARNING The combustion chamber insulation in this appliance contains ceramic fiber material. Ceramic fibers can be converted to cristobalite in very high temperature applications. The International Agency for Research on Cancer (IARC) has concluded, "Crystalline silica in the form of quartz or cristobalite from occupational sources is carcinogenic to humans (Group 1)." Normal operating temperatures in this appliance are below the level to convert ceramic fibers to cristobalite. Abnormal operating conditions would have to be created to convert the ceramic fibers in this appliance to cristobalite.

The ceramic fiber material used in this appliance is an irritant; when handling or replacing the ceramic materials it is advisable that the installer follow these safety guidelines.

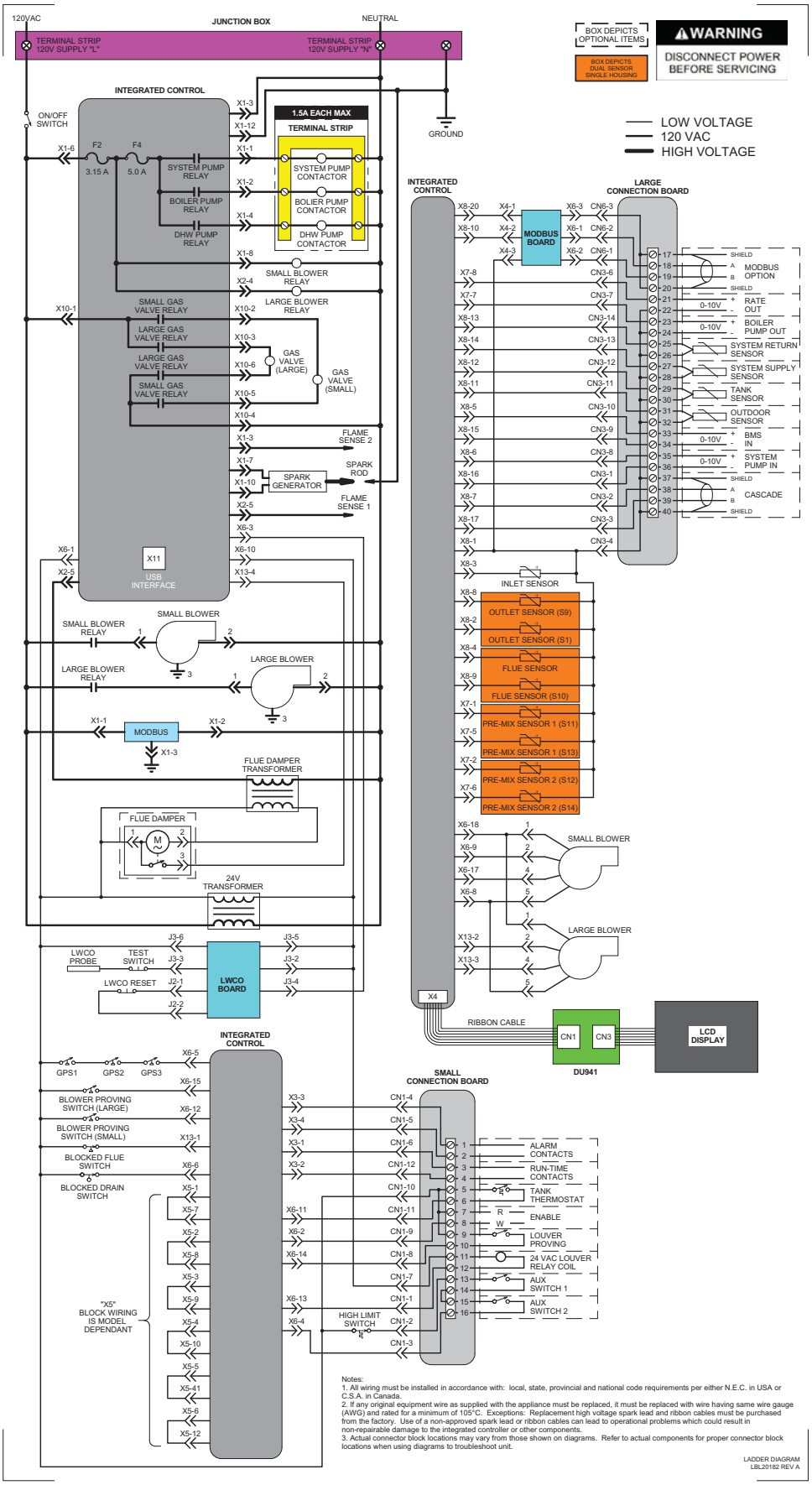
- Avoid breathing dust and contact with skin and eyes.
  - Use NIOSH certified dust respirator (N95). This type of respirator is based on the OSHA requirements for cristobalite at the time this document was written. Other types of respirators may be needed depending on the job site conditions. Current NIOSH recommendations can be found on the NIOSH website at http://www.cdc.gov/niosh/homepage.html. NIOSH approved respirators, manufacturers, and phone numbers are also listed on this website.
  - Wear long-sleeved, loose fitting clothing, gloves, and eye protection.
- Apply enough water to the combustion chamber lining to prevent airborne dust.
- Remove the combustion chamber lining from the boiler and place it in a plastic bag for disposal.
- Wash potentially contaminated clothes separately from other clothing. Rinse clothes washer thoroughly.

NIOSH stated First Aid.

- Eye: Irrigate immediately.
- Breathing: Fresh air.

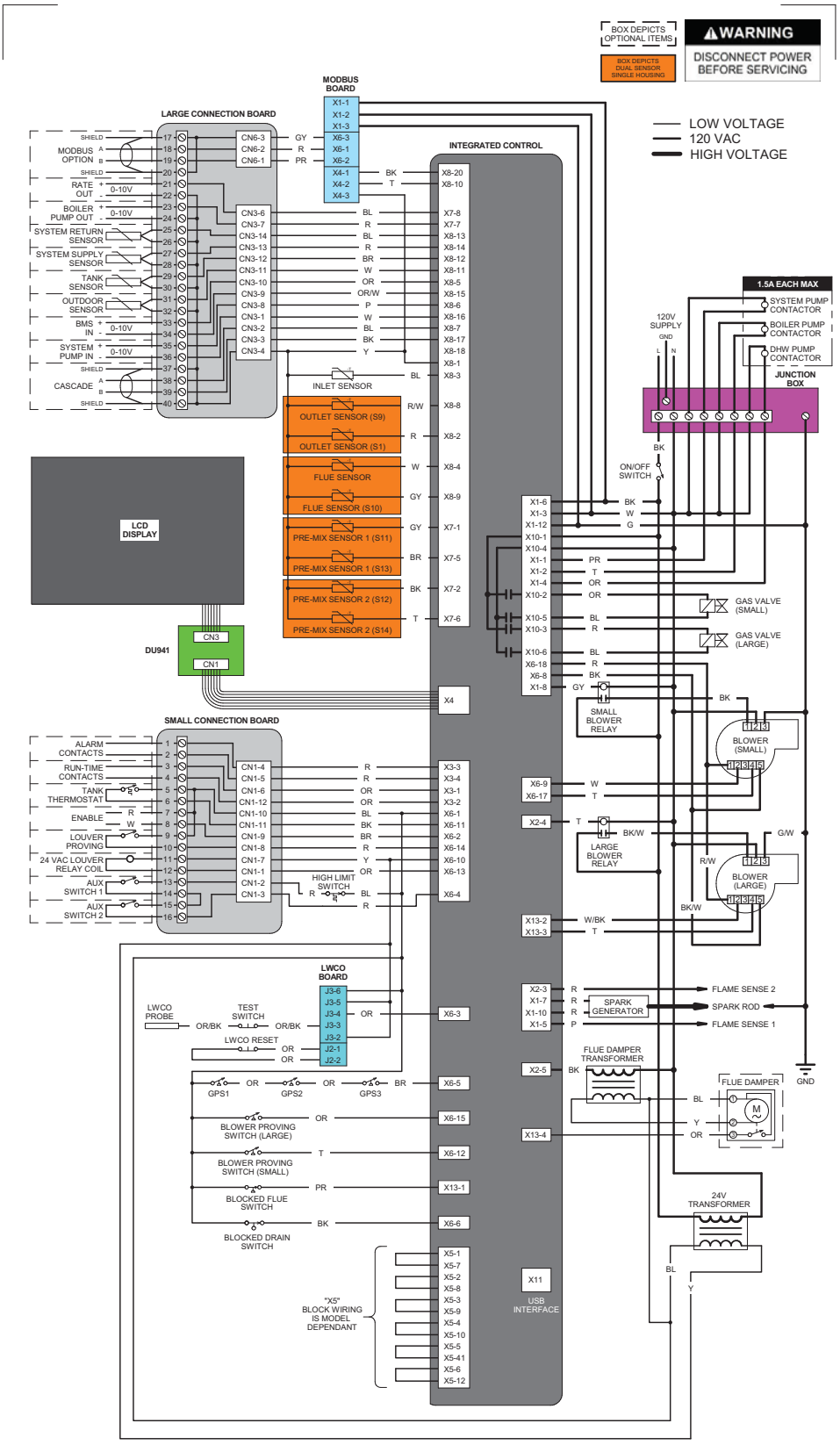
12 Diagrams

Figure 12-1 *Ladder Diagram*



12 Diagrams *(continued)*

Figure 12-2 *Wiring Diagram*



Notes:
1. All wiring must be installed in accordance with: local, state, provincial and national code requirements per either N.E.C. in USA or C.S.A. in Canada.
2. If any original equipment wire as supplied with the appliance must be replaced, it must be replaced with wire having same wire gauge (AWG) and rated for a minimum of 105°C. Exceptions: Replacement high voltage spark lead and ribbon cables must be purchased from the factory. Use of a non-approved spark lead or ribbon cables can lead to operational problems which could result in non-repairable damage to the integrated controller or other components.
3. Actual connector block locations may vary from those shown on diagrams. Refer to actual components for proper connector block locations when using diagrams to troubleshoot unit.

WIRING DIAGRAM
LBL20181 REV A

Revision Notes: *Revision A (ECO #C07970) initial release.*

Revision B (ECO #C08023) reflects changes made to FIG. 6-3 on page 32 for Mass approval and changes made to FIG. 5-3 on page 28.

Revision C (ECO #C08179) reflects the addition of three (3) new vent manufacturers (pg. 16 - Table 2A).

Revision D (ECO #C08585) reflects edits made to FIG. 4-4 and the addition of Fixed or Variable Flow Primary in place of Full Flow.

Revision E (ECO #C08841) reflects changes made to #3 on page 42 additional information added to the humidity warning on page 7, along with references to the Dual Fuel Supplemental Manual.

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